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STANDARDS OF LIGHT.

We note in the Digest some of the results reached by the International Photometric Commission, which met in Zurich a couple of months since. While the action taken was rather tentative in its nature and can hardly be expected to establish an international ruling, it will certainly be of service in clarifying the issues and in helping to bring about a general convention regarding luminous standards, which is at present much needed. There have been numerous attempts to settle *ex cathedra* upon luminous standards, usually by bodies which, like the congress that established the Violle standard, had real authority to speak for nothing save itself. The whole matter is so complex that it will take many preliminary conferences to pave the way for concerted action, and the present one is valuable especially in that it has brought up to date the facts regarding the concrete primary standards which are now in use. The commission certainly represents a high degree of experimental skill and the results presented will carry no inconsiderable weight. At the present moment the three standards of sufficient importance to be considered are the hefner, the pentane standard and the carcel. Of these the last-named derives more importance from its still considerable use than from its intrinsic excellence. In uniformity and reproducibility it leaves considerable to be desired, although its color and magnitude make it convenient for the comparison of flame sources. We doubt whether, as a primary standard, it can fairly be considered eligible for final choice so that in lack of anything better the hefner and the 10-cp pentane standards have the field to themselves.

Yet even these are far from ideal, the former by reason of its small power and inconvenient color, the latter on account of its relative complication and relatively large variations with atmospheric conditions. Leaving the carcel out of consideration, the values adopted by the commission make the Harcourt standard equal to 10.95 hefners; or the hefner equals 0.913 pentane candle. Previously the hefner has been generally held to equal 0.88 Parliamentary-candle, so that there is an outstanding discrepancy of about 3 per cent between the two definitions. The value 0.88 is the one adopted by the American Institute of Electrical Engineers and by the Bureau of Standards, so that practically the American standard "candle" varies from the present canonical value of the British "candle" by the amount just given. If this were the whole story the issue would be simple enough. But in an admirable paper by Dr. Hyde, of the Bureau of Standards, it appears from direct comparison between the Harcourt and the standard incandescent lamps of the bureau, and between these and the hefner, that the relation between the Harcourt and the hefner is not 10.95, but 11.19. This gives the hefner equal to 0.894 pentane-candle, a value about half way between the new and the old ratios. In fact, various direct comparisons give this ratio all the way from 0.88 to 0.933. The fact remains that there is an outstanding discrepancy of 5 per cent to be accounted for in some way.

It must be admitted that the situation is a difficult one. In some respects the values obtained via incandescent lamps should be more reliable even than direct comparisons since each flame standard can then be worked in its home laboratory, while the incandescents seem to be reliable between themselves to a highly satisfactory degree. Still, there must be taken into account the well-known advantage of comparing flame standards with each other under identical atmospheric conditions as against applying the full value of the atmospheric corrections when checking incandescent lamps. This is one reason for the hesitancy of gas photometrists in using the otherwise extremely convenient incandescent standards. It seems to us that there is much room for improvement still in flame standards when variations as large as those noted appear in the careful work of skilled investigators. Certainly it would seem possible to devise a lamp while burning, like the hefner, an entirely definite chemical compound, should yet give a better magnitude and a color nearer to that of modern illuminants.

The carcel and the recent kerosene lamp of Dr. Elliott show the results that can be reached by methods comparatively crude as regards the material burned, while the hefner is a good example of what can be done with a constant fuel in spite of small dimensions, naked flame and inconvenient color. There is, of course, a comparatively unexplored field in the metallic filament incandescents, but the failure with platinum, which is relatively easy to obtain in pure condition and to manipulate, is somewhat discouraging. The investigation leading to a satisfactory primary standard of light will be a long one since not only has the thing itself to be found, but the inertia of long usage must be overcome. As a preliminary step, however, it should be possible to establish an international "candle" or other unit of intensity to which each country could attach its value in terms of its own pet primary source. The unit in terms of incandescent lamps is amply easy to manage and would at least give photometrists the advantage now denied them of working in terms of the same thing with the same name everywhere. When the concrete primary standard comes it can be adjusted in magnitude to a simple ratio with the unit.

Telephonic Distortion.

Elsewhere we print an interesting contribution by Mr. Louis Cohen calling attention to the apparent neglect by investigators in the past of the influence of skin resistance on telephonic transmission; that is, of the increase of the resistance of a conductor with increase of frequency caused by unequal flow through the cross section of a conductor by the action of self-inductance which crowds the current toward the surface, whereby the conductive medium is unequally utilized. The practical bearing of this consideration depends largely upon the telephonic speech value of the current components of higher frequency, for at the lower and predominant frequencies the skin effect may be negligible. We note that in the present case, as in the case of other writers on the subject of telephonic distortion, the term distortion is connected only with the effect of attenuation. This use appears to ignore the fact that the effect of reactance not only attenuates differently the values of current components, but also changes their phase relations—in the first case affecting the tone value, and in the second case the word form.

What Constitutes Good Street Lighting.

The paper by Mr. W. H. Blood, Jr., on "What Constitutes Good Street Lighting," which was read before the convention of the Illuminating Engineering Society and summarized in our issue of Aug. 10, well represents the views of a great many central station men and illuminating experts on what should be sought in street lighting. Mr. Blood took the position that smaller units than are now common are desirable; or, in other words, that incandescent lamps of high efficiency located at frequent intervals enable one to see the way along a street much better than large arc lamps at less frequent intervals, as there is less variation between the maximum and minimum illumination on the street, and, hence, for purpose of pathfinding the street is better illuminated. Any observer who has ever walked or driven on shaded streets at night, illuminated by frequent incandescent lamps, and on streets lighted by arc lamps at infrequent intervals can testify to the truth of these statements. As a matter of fact, much of our street lighting is not beyond the stage of pathfinding, and whatever system makes it easiest to see the path at a given expenditure per mile of street is logically the most desirable. There are, nevertheless, a number, even among illuminating engineers, who point to the brilliant effect produced by arc lamps which is impossible with incandescents, and claim that the high maximum intensity near the lamp is not altogether a drawback, as it helps make a well-lighted effect whether the street is actually well lighted for purposes of finding one's way or not. There appears to be a place for both systems of lighting. In the numerous towns where arc lamps are placed every second corner in the residence districts, there is no question at all but that an equal amount of energy in incandescent lamps would enable citizens to see their way around the streets much better. The arc lamp at such infrequent intervals is simply barbarous, because of the violent contrasts and deep shadows which result. On the other hand, on business streets where arc lamps can be placed on every corner or even closer, the blinding effect and contrasts are not pronounced enough to cause trouble, although even in such places opal diffusing globes might well be used to lessen the glare.

Incandescent Lamp Specifications.

The extent to which the U. S. Government proposes to employ incandescent lighting during the forthcoming fiscal year is indicated by the fact that proposals have recently been invited for 270,000 incandescent lamps, as detailed in our issue of August 3. These proposals are noteworthy, since they are the first of their kind to employ mean spherical candle-power as a basis of comparison. This distinctly marks a step in advance. The rating of the lamps called for remains on the mean horizontal candle-power basis, as is customary, but the initial specific consumption called for is 3.76 watts per mean spherical candle, corresponding to 3.1 watts per mean horizontal candle, when the spherical reduction factor is 82.5 per cent. Not only is the mean spherical candle-power basis the most nearly accurate from a technical standpoint, but it is also the only safe standard of valuation in comparing lamps of different types and manufacture. There are many conditions in which increased candle-power in some particular direction is preferable to a nearly uniform distribution, as, for example, the

case of a single incandescent lamp, without globe or reflector, suspended above a reading desk. In this case a type of lamp with powerful end-on candle-power with weakened horizontal intensity is preferable to a lamp of the usual type. No proper comparison of the two types of lamp would be possible on the basis either of end-on candle-power or of mean horizontal candle-power. The true comparison would, however, always be available on the basis of mean spherical candle-power. The government engineers who formulated the department specifications have performed an excellent service to electric lighting in requiring the commercial recognition of the spherical candle-power which had too long been denied.

COLOR PHOTOMETRY.

The very interesting letter on this topic from Dr. Lummer which appears elsewhere in our columns, raises anew some important practical questions. It has certainly been far from our purpose to criticize the admirable Lummer-Brodhun screen for failing to do what it was never expected to accomplish. The fact is, however, that some writers on photometry have been, by the very care of setting which characterizes the instrument, misled into thinking that it is particularly adapted for the very thing which Dr. Lummer himself vigorously disclaims. Hence it seems desirable to set them right. Exact results in the comparison of fields varying widely in color are certainly not yet attainable; however, consistent readings can be obtained by an observer at a particular time. One of the hardest lessons for the experimenter to learn is that consistency does not imply precision in the final result. As Dr. Lummer suggests, there may be some doubt as to the real value of comparisons between very different colored fields. The difficulties of color photometry, however, are very seriously involved in the comparison of our present commercial illuminants, and hence cannot be laid aside even if the results are known to lack in precision. It is a case where one must do the best he can even with unsatisfactory methods and instruments.

For instance, it has become necessary to compare lamps differing in color as much as the flaming arc and the enclosed arc, the incandescent lamp and the mercury vapor tube. Not only do these vary immensely among themselves, but they all differ conspicuously from the scale of color values found in average daylight. These, in turn, range from a light redder than the hefner to one bluer than the enclosed arc. It is a case then of making the best of a bad proposition, and of trying to devise a fair method of approximation rather than a satisfactory method of exact measurement. It may very likely turn out that one must, in color photometry, be satisfied with methods which would be quite inappropriate for the comparison of fields approximately alike in color. Facing the problem as one finds it, one of the exasperating preliminary troubles is that there is no general agreement upon a definition of what shall conventionally be called white. The Welsbach, acetylene, metallic filament incandescents, Nernst lamps, and even the Moore tube and the enclosed arc, have been exploited vociferously as white. And lately the magnetic arc has been added to the list of aspirants. It would seem desirable to establish some uniformity in color nomenclature before trying to compare a "white" enclosed arc with a "white" Welsbach. This matter aside, there remains a practical color difference between these various sources so great as to defy proper evaluation in spite of the fact that the lamps concerned are really in commercial competition.

It seems to us that the work which Dr. Lummer has in progress regarding the sensibility of the eye to various spectral colors is much to the point. Previous work on this point has hardly been carried far enough to serve as a basis for anything like a commercial criterion. One of the possible methods of dodging the color difficulty is to assign, by obtaining the average results from a very large number of normal eyes, conventional standard values for the luminosity of each spectral region, so that light sources may be compared by a relatively simple spectro-photometric method. Another plan is that of Crova, many years since—using a colored screen permeable only to the colors of high luminosity, and, therefore, reducing the lights to be compared to approximately the same color. We fear this scheme, fair as it undoubtedly is for most sources, would cause a riot when applied to some of the illuminants at present employed. Again, one might find it possible to use some sort of reading-comparison photometer which should give a fair approximation to the practical value of the sources compared for seeing purposes. It is not without the bounds of possibility, too, that a constant might be found to connect the luminosity values for the average eye with the effect of the beam upon a selenium cell. In fact, the whole range of photometric appliances must be gone over before the question is finally settled. And, first of all, it is well worth while for a thorough investigation to be made of the actual errors committed in balancing lights of different colors with the usual screens.

It is true, of course, that the Purkinje phenomenon is extremely troublesome in such work, but it is not so clear that its effect cannot be allowed for, if one were using a standard, conventional method of working. If one could connect the actual relative luminosities of the lamps as determined by the spectro photometer, with the settings made under standard conditions, it might turn out that reasonable precision would be attainable. The amount of personal equation in setting a photometer screen on colored lights, aside from Purkinje's phenomenon, has never been sufficiently studied, nor is the constancy of the personal equation satisfactorily known. There is pretty good reason to expect that it may be subject to large variations in the same person, and it is not yet clear whether these are or are not controllable. The real fact is that, as Dr. Lummer very truly says, we are quite at sea in color photometry. There is a prodigious amount of work to be done merely in gathering the data necessary to the formation of an intelligent judgment on many of the points involved, the more since it looks very much as if the reactions of the average eye to color would have sooner or later to be determined. The study of the color sense is so laborious that most investigators have been per force content with a few "subjects." Yet when it was possible to chance upon, as did one experimenter, two cases of an altogether exceptional aberrant color sense in the same laboratory, it is clear that safety lies in considerable numbers. It is a case for carefully laid-out co-operative research, if results are to be obtained in a reasonably short time. The Illuminating Engineering Society and allied bodies have plenty of work ahead of them along these lines, and they will do well to start in at once, lest they be overwhelmed by still more illuminants.

The Exhibits and the Awards Jury at the Jamestown Exposition.

Last week, under the presidency of Dr. Albert Shaw and the vice-presidency of Mr. Ambrose Swasey, the jury of awards of the Jamestown Exposition took up its work. The jury in this instance has been limited to about 75 members, chiefly university officials, government experts and men prominent in technical bodies. From this body and its departmental groups no appeal is permitted by the rules of award, but a superior jury has been constituted to take care of various difficult points that arise in such work. The whole week was devoted by the jury of awards to its task, and the present week will probably see the close of the work of its jury of review. It is understood that the awards will be announced early in October. While the exposition is relatively small, it is in some respects very select, and the rules have aimed to limit the award of only one medal to any exhibitor in any given department. Hence the work of the jury has been of an unusually critical nature.

In the general group of machinery, electricity and transportation, Mr. J. M. Dodge was made chairman of the machinery and transportation section, and Dr. Carl Hering chairman of the electrical section; both having great familiarity and experience with the work. The department group for electricity comprised Dr. Carl Hering, Prof. B. V. Swenson, secretary of the American Street and Interurban Railway Association; T. C. Martin, editor, Electrical World, and C. T. Malcolmson, expert, U. S. Fuel Testing Plant. Prof. Swenson was also a juror in the transportation section. The electrical jury considered exhibitors in Class 79, telegraphy and telephony; 80, electro chemistry; 81, electric lighting; 82, various applications of electricity; 143, working of mines electrically, and 146, electrometallurgy. The exhibits in these classes were chiefly in the Machinery Building, but were scattered also throughout the various departments, owing to the fact that electricity is now so pervasive in its influence and effects, it is hard to name any branch of human effort or experiment in which electrical energy is not employed.

During the week the officers of the jury, with the support of the whole body, adopted resolutions commending the exposition to the people of the United States as worthy of visitation and cordial support. In view of the nature of the productions of the Southern States, emphasis is everywhere laid on the agricultural and mineral productions of the various commonwealths, but the machinery section is altogether of an excellent character; and it is probable that no previous exposition has seen so many industrial and domestic applications of electric light, heat and power. Moreover, the lighting of the exposition is admirably done, and Mr. W. M. Dixon, assistant director-general and electrical chief of installation, has achieved notable success in spite of the obstacles in his way. About 75,000 lamps of 8 candle-power have been used in outlining the main buildings, and there are eight searchlights on the Administration Building employed to throw broad beams of light seaward over the water gate, after the manner of a streaming aurora borealis. These lamps are supplemented by at least as many incandescents on the Warpath, and by other searchlights. The buildings make free use of a dull red brick that absorbs light, but the general accentuation of outline is admirably carried out. In addition there is, on Raleigh Square, south of the Grand Basin, an electric fountain, of the concealed chamber type, with colored screens passing in front of the arc lamps, whose beams are projected upward through the jets of water. The manner in which the exposition is supplied, by a large sub-station, from the system of the local traction and lighting company was described in these pages some months ago. It is needless to add that this system has been very heavily taxed this summer; now that the exposition has "found itself," now that cool days are coming with leisure for the Southener, and now that the beautiful spectacle on the historic Hampton Roads is fully set, the burden of travel is reaching its peak, and the whole plant is working to the limit.

The jury of awards on the transportation group consisted of five members, three of whom were present and filled in an arduous week, viz., Prof. B. V. Swenson, Prof. G. Lanza, of the Massachusetts Institute of Technology, and Mr. C. T. Malcolmson. The electrical exhibits in this group were also considered by the electrical jury. All possible courtesies and help were extended by Mr. T. S. Southgate, governor of exhibits; Mr. J. L. Farmer, secretary of the jury of awards, and Capt. J. E. Reinburg, chief of the departments of machinery and marine. The jury lunched daily at the Swiss Alps Village to discuss work and details, and the Army and Navy Club also threw open the hospitable doors of its cozy home on the outskirts by the water, near Machinery Building. During the week a most interesting trip was made over the electric division of the Norfolk & Southern Railroad to Virginia Beach and Cape Henry, at which place the United States navy has a fine wireless station, where considerable testing and experimental work is being carried on and where some most valuable data have already been accumulated.

The Trend of Invention and Improvement in the Electric Field.

The August issue of the *General Electric Review* contains an interesting article by Prof. Elihu Thomson discussing the trend of invention and improvement in the electric field. This article is reprinted, practically in full, below.

The electric industry did not reach any considerable development until the beginning of the decade between 1880 and 1890, when numerous discoveries and inventions were made, following each other in quick succession. Upon these the industry was founded, although some of the early work was not applied in actual commercial form until quite recently.

For a long time the open-type carbon-arc lamp alone served in arc lighting. Some 10 or 12 years ago the movement towards restricting the access of air to the carbons and thereby saving evpense in renewals of carbons and trimming the lamps took place, and resulted in the enclosed-type of arc lamp. A few years later, however, the superior efficiency of the so-called luminous arc drew attention to new types of arc lamps, in some of which the carbon in the electrode served only to confer conductivity, while the light was no longer due to the bright positive carbon crater, but to the presence in the arc flame of vapors and fine particles of refractory substances. The comparatively short life of the electrodes, however, as compared with those of the enclosed arc gave again the disadvantages of the open arc in frequent renewals and trimming.

The present trend of invention is towards securing not only the superior efficiency of the luminous arc, but by a selection and combination of suitable substances, a long life of the electrodes. The inventor has the task of finding the best combination, and constructing a lamp mechanism which will properly take care of the arc adjustment. Work in this field will doubtless continue actively for some years as the possibilities are not yet exhausted in the experiments hitherto made.

While formerly the constant-current arc dynamo with series circuits was universally used, we find its place taken by the constant alternating-current transformer, and this may eventually be used in combination with rectifying apparatus, such as the mercury arc, and a return to direct-current arcs may thus take place. Invention in this field has been quite active, and will probably continue until practical perfection of construction and operation is assured. The tendency in stations is to unify the supply, so that instead of arc machines, constant potential low-tension dynamos, railway generators and alternators being found, large generating units of the alternating-current type are alone installed, the current from which by transformers, rotary converters, rectifiers, motor generators, etc., is adapted to varied kinds of load. Practically to-day the station supply is alternating except in railway work not involving transmissions at high voltage and transformation.

The various new conditions of regulation and distribution will doubtless continue to furnish a field for the exercise of inventive genius as has been the case in the past.

In the incandescent lamp, carbon, which for so long held its own as the best material for filaments, is likely to be eventually replaced by metals possessing high melting point, and, what is of the utmost consequence in this connection, a low or negligible vapor tension when near melting. Carbon, while quite infusible, fails in being too volatile at such temperatures as are necessary to be attained in the incandescent lamp if it is to be efficient. While improved greatly by "metallizing" it cannot be expected to possess a reasonable life of run at a specific consumption of only one-half of that which can be attained in the latest lamps with metallic filaments, notably in the tungsten lamp.

Beginning with the rare metal, osmium, as the first substitute for carbon, we have seen in succession tantalums and tungstens. We may rest assured that the refractory metals which are not too rare or costly will be scrutinized very carefully in the effort to find whether they are possessed of the properties needed for use in a lamp filament. These are briefly, high fusing point, low vapor tension, when near melting, high specific resistance, and capability of being formed into pieces of the lengths and sections desired in the lamps. A new era of incandescent lighting has begun, although much work yet remains to be done, which will involve great skill in manipulation and perhaps discovery. The advent of a lamp requiring about one watt per candle cannot fail to profoundly affect the progress of electric lighting, and tend, when small units are available, to render electric lighting far more general than is now the case. Existing mains will serve for a much larger output in light, and, with the high economy lamp, day current may be with advantage employed to charge batteries on the customers' premises, which are discharged for lighting at night; thus tending to a relief of the load peak. In a station supplying electric energy for motors and lamps, any gain in efficiency of the lamps will make the peak less pronounced.

In the application of electric motors, as in railway or stationary work, the improvements or inventions will naturally relate more and more to details. It is probable that no radical departures from present constructions can be economically made.

The recent revival of the inter-pole for assisting commutation has already had a very important effect on dynamos and motors, leading to increased voltage and output rating, and giving to the continuous machine an added value. The alternating-current generators and motors, both single and polyphase, are at present highly developed machines, and the improvement is not likely to involve any radical departures. Lessened cost, saving of material, ease of maintenance will continue to be sought by the designer or inventor.

The endeavor to secure variations of speed in motors has led to some ingenious modifications of the machine. In like manner the demand for railway car lighting has led to the invention of generators having a nearly constant output notwithstanding great variations of speed, as when the driving is from the car axle. This kind of specialization of machines will doubtless continue to afford in the future a field for the exercise of inventive talent.

The future progress will probably depend as much upon refined engineering and construction as upon invention, except in special instances similar in character to the examples mentioned. We can see no reason to expect great revolutions in methods or apparatus as a result of new inventions yet to be made. The art is old enough to permit standardization and there is much less danger than formerly that portions of the plant will soon become obsolete.

In the comparatively new field of wireless telegraphy there is still considerable room for invention and improvement, but it is remarkable what progress has hitherto been made. It is hardly likely, however, that this art will be developed to such an extent that it will replace for communications of intelligence existing wire circuits. It will rather tend to supplement such service and occupy fields peculiarly its own, which it does already in furnishing means of communication with vessels at sea.

Fixation of Nitrogen.

A patent issued Sept. 10, to Dr. C. P. Steinmetz, describes a method for the fixation of nitrogen from the atmosphere by submitting air to the action of an electric arc of minimum volume and the greatest practicable length. The former process in which short arcs have been used is criticized on the ground that it requires a great number of electric arcs and high tension currents, is expensive and troublesome and the apparatus employed is liable to get out of order, while owing to the multiplicity of the arcs readjustments and repairs are troublesome and time consuming. It is claimed that by the process described these difficulties are overcome by the employment of a single electric arc maintained by direct current, which arc is magnetically deflected or drawn laterally to a distance within which it can be safely maintained, and also magnetically rotated within its sphere of action so as to sweep through the air which is to be converted into nitrous compounds. As illustrated, the arc is established between electrodes entering a cylindrically enclosed chamber, and an electric motor rotates about the cylinder two opposing electrical magnates, the legs of which project inwardly toward the air chamber so that the magnetic flux passes substantially at right angles with the axis of the arc. In this manner the arc is both deflected and rotated, the latter motion serving the double purpose of extending the sphere of action of the arc and of limiting the time within which the arc acts upon any portion of the air which passes through the converting chamber.

Making Nickel and Cobalt Films.

Two patents were issued Sept. 10, to Mr. Thomas A. Edison on a process of making metallic films or flakes, particularly of cobalt or nickel or of cobalt and nickel combined, such as are used in the Edison storage battery. In making, for example, cobalt films, the cathode, consisting of a copper cylinder having a polished, nickel-plated surface, is first immersed in a cobalt plating bath and rotated, whereupon an extremely thin film of cobalt is deposited, the thickness being .0001 of an inch or less. The cathode, after being washed, is then immersed in a solution of copper sulphate which causes the cobalt to go into solution and copper to be deposited as "cement copper" in a granular but slightly adhesive form. The cathode is then introduced into a copper plating bath and a thin film of copper plated on the chemically deposited film of "copper cement," during which process the cathode is rotated. The cathode is then finally introduced into a cobalt bath in which a film of cobalt of about .0002 of an inch is deposited. The operations described are repeated, alternate layers of copper and cobalt being deposited on the cathode until a composite sheet of the desired thickness is secured. The sheets are then cut into long strips and introduced into a bath into which the copper is dissolved without affecting the cobalt. After washing the films thus obtained they are annealed in hydrogen prior to being used in storage battery plates.

Variable-Speed Induction Motor.

A solution of the problem of obtaining good running characteristics in an induction motor having a high starting torque is given in a United States patent recently issued to Mr. F. M. Lewis, of Brighton, England. Each primary phase winding is divided into two parts, one of which can be electrically reversed with reference to the other when desired by means of a throw-over switch. There are two electrically-distinct and separately-insulated secondary windings, one of high resistance and the other of low resistance. The high-resistance wind-

ing is of the squirrel-cage type, while the low-resistance winding consists of a succession of wave or continuous windings of the same solar pitch as the primary.

Assuming an eight-pole machine, under running conditions the primary connections would be such as to make the relative polarities *N, S, N, S, N, S, N, S.* Normal current traverses the low resistance wave windings, but very little current flows through the high-resistance winding. Under starting conditions the primary connections are so arranged as to make the relative polarities *N, S, N, S, S, N, S, N,* so that no current flows through the low-resistance winding because the e. m. f. in one-half of it opposes that in the other half, but current flows in the high-resistance winding and gives a large starting torque to the rotor.

New Incandescent Lamps.

In a paper read by Mr. Leon Gaster at the recent meeting of the British Association for the Advancement of Science, entitled "Developments in Electric Incandescent Lamps," the subjects of the tungsten and helion lamp were treated in some detail.

Credit is given to Dr. H. Kuzel, of Vienna, for being one of the first workers on the tungsten lamp. By his process the metal is obtained in the colloidal state by means of an arc under water. The resulting paste of extremely fine metal is squirted into filaments, and afterwards heated in order to make them better conductors. The lamps are manufactured in Vienna by Kremenetsky. From such tests as have been made it is ascertained that the lamps consume a little over one watt per candle-power, with a useful life of about 1000 hours, with a loss of only 10 to 15 per cent of the initial candle-power.

Another method of manufacturing tungsten filaments is the joint invention of Dr. Alexander Yust and Franz Hannaman, of Vienna. According to their process the carbon filament is electrically raised to a high temperature in an atmosphere of gaseous tungsten or molybdenum compounds. The carbon then becomes coated with metal, and after burning out the carbon, the filament appears quite homogeneous even under the microscope. By another method the metallic powder is prepared by chemical means mixed with an agglutinant, and squirted into the form of filaments, which are then freed from carbon as before.

Various other processes have been devised for preparing a paste of the oxide of tungsten, which can be squirted in filaments and afterwards reduced. According to the British patent 4814 of 1907, Messrs. Siemens & Halske have devised a process of stamping tungsten powder, sometimes mixed with another metallic powder, but without an agglutinant, in a tube of some metal, which is easily drawn or rolled, such as tantalum or iron. Then, after electrically sealing the ends, they subject the tube to drawing or rolling processes. After the completion of the drawing process the outer skin can, if desired, be removed. This method obviates the necessity for the great care and treatment involved in the ordinary fusing process, but it was not stated whether the method is actually in use. The diameter of some of these metal filaments is very small, lying between 0.05 mm and 0.03 mm. A filament yielding 60 candle-power at 110 volts requires to be over 600 mm long.

Experiments which attempt the manufacture of filaments of smaller diameters, such as permit the production of lamps of 110 volts and of about 20 candle-power, are in progress, and some lamps of such small candle-power and even of high voltages have already been made on a laboratory scale, one of these being made at the Robertson Lamp Works, in London. The average life of these tungsten lamps for the present can be reckoned to lie between 600 and 700 hours; some lamps have been burning as long as over 2000 hours.

The next lamp using tungsten, and which is already used commercially, is the "osram" lamp, and it is the invention of Dr. Aeur von Welsbach. The lamps are for the present manufactured by the Deutsche Gasglühlicht Gesellschaft, and are imported by the London General Electric Company, who have decided to begin the manufacture of the same in England. The lamps are made in various sizes up to 100 candle-power, and for varying voltages, but the common type which is expected to be used in the near future will be intended for voltages lying between 100 and 130, and of 35, 50 and 100 candle-power. The lamps burn with a consumption of 1.2 watts per candle-power, having a useful life, on an average, of over 600 hours. The candle-power is well maintained over the whole useful life of the lamp. The lamps are recommended to be burnt for the present with the filament in a vertical plane, and can be equally well used on direct or alternating current circuits.

The Berlin A. E. G. Company is also manufacturing some type of tungsten lamps, the process for the manufacture of which has not been divulged. The lamps are made for various voltages, one being of 50 hefners at 100 volts. The Zircon Wolfram lamp has been much improved during the last few months, and certainly represents a great advance over the lamps previously mentioned. It is the first metal filament lamp of a voltage above 100 which burns satisfactorily in any position in the chandelier. The filaments are mounted on spring hooks made out of tungstenized carbon, the hooks having the effect of maintaining the filament rigid and in shape, while in service, and of preventing the loops from touching, and also allow of a greater number of filaments in the bulb, and, consequently, reducing their length and that of the lamp. The lamps can be burned in any position, and the breakage of filaments is considerably reduced. On account of the elasticity of the spring hooks, the breakage of filament has been reduced in transit and in service.

Another improvement over the old type of lamp is the adoption of electrical soldering of the filament to the leading-in wires, thus doing away with the inconveniences caused by the use of graphite paste, which was a partial cause of the blackening, the giving off gases, and the defective contacts met with in the previous lamps. The improvement also avoids much extra labor, and also the danger of oxidation of the filament, if the paste is not very carefully burned away. The electrical soldering process takes place in the open, and an experienced operator can carry out the soldering of about 500 lamps daily. The firm of La Carriere, in Paris, are the inventors of this spring hook, and the filaments can now be mechanically mounted in such a manner that the operators do not have to touch them with their fingers, thus reducing thereby the number of breakages in mounting the filaments. One operator can mount about 500 lamps of 110 volts daily. The latest type of 110-volt lamp contains only four filaments, of 0.025 mm diameter, giving 24 hefner candles; or for 220-volt 48 hefner candles necessitating the use of only eight filaments. Lamps can also be made of 150 to 200 candle-power to compete with small arc lamps for shop and street lighting. The progress made in England with the use of this lamp has not been great, but arrangements have been made for a factory to be established in London for the manufacture of filaments, and the subsequent sale to lamp makers.

The helion lamp invented by Prof. Parker, of Columbia University, and Mr. W. G. Clark looks like an ordinary carbon incandescent lamp mounted in the same sized bulb, and is a 100-volt lamp, consuming 35 watts, and gives out 30 candle-power. In the manufacture of the filament silicon is reduced from a gaseous form in combination with carbonaceous gases on the surface of a high resistance carbon core. The inventors claim that this lamp operates at a high temperature without the carbon and silicon uniting to form carborundum as might be supposed. The silicon shows no tendency of becoming molten or fluid at the temperature attained. The filament starts with a negative temperature coefficient less than carbon, but at about a red heat the coefficient changes distinctly to positive, and remains so as the temperature is further increased. The consumption of the lamp is claimed to be from 1 to 1.2 watt per candle, or it can run even at less. Although a useful life between

600 and 1000 hours is claimed, a proper series of life tests could not be made, as there seems to be a difficulty in keeping the joints between the filament and the leading-in wires in good condition. For the proper working of the lamp, it is essential that mercury vapor pumps must be used for obtaining the vacuum, and great care must be taken in selecting the carbon core, so as to obtain homogeneity and purity, otherwise the results are considerably affected. Experiments are now being conducted by the inventors, using as a core the graphitized carbon filament. The inventors are also experimenting with a special cement for the use of making the joints, and, it is said, that the results are promising. One of the characteristic features of the lamp is that the length of the filament need not be increased over the ordinary carbon lamp. The filament is very pliable, and there will be no difficulty (if the present defects, which are chiefly of a mechanical character, have been overcome) in making lamps of low and high voltages and of reasonable candle-power. The lamp easily stands transport, and will be just as safe to handle as the ordinary carbon filament lamp of to-day. This is rather an important point, because one of the troubles common to all metal filament lamps at the present is their liability to breakage in transport and in handling, particularly so at the hands of the uninitiated consumer. The advantage to be derived from the use of metal filament lamps may often more than be counterbalanced by the expenditure for renewals of lamps, on account of the breakage of the filament.

Iridium has also been used for the manufacture of lamp filaments. According to Gulcher's process, amorphous iridium is made up into a paste by the aid of an organic binding material. The filaments are squeezed from this paste, and are made to glow in the air, and not in a receiver containing air in the diminished pressure or indifferent gases. The lamp is only produced for low voltages, up to 24, and consumes between 1 and 1.5 watts per candle. Other metals, like vanadium, niobium, molybdenum, etc., may also be used in the future, but not much has been made public as yet regarding their use for filaments.

In speaking of the economies which can be derived by the use of those new metal-filament lamps, one naturally has to bear in mind the fact that the economy to be derived depends on the price at which the lamps could be sold, the rate of charge for the current used, and the useful life of the lamp, and this is a matter which requires proper calculation, and which one must not overlook when tempted to adopt these new metal-filament lamps for the sake of economy only. The question of breakage in transport and in handling by dusting or fixing the lamps is a very serious drawback, and to mitigate this evil the lamp makers will have to work out an arrangement with the consumer so as to reduce this expense to a minimum. The price of the lamp of 100 volt, 50 cp., is 4 shillings, but there is no doubt that this high price, with an increased output and growing demand, will be greatly reduced in the near future.

Although we have seen that the metal-filament lamps can be made of relatively small candle-power at voltages above 100, and of high voltage up to 240, it is stated that it is not the intention of most of the manufacturers sell for the present other lamps than those of high candle-power above 30 cp, and intended for voltages varying between 100 and 130. This decision has a distinct commercial value, making the change from the carbon filament to the use of metal filament gradual, so as to be properly appreciated and beneficial to the consumer, manufacturers and energy suppliers alike. The fact that the high-cp lamps consume only about one-third or even less energy than generally the present carbon lamps, will, to a very large extent, meet the complaints of the consumer, who, in adopting the lamps, will obtain increased illumination at the same or less energy expenditure than hitherto. It is well known that the carbon incandescent lamps are at present in many cases fixed at a low position, often situated in the direct angle of vision, and, therefore, detrimental to sight. The reason may be that, on account of the expense at which energy is supplied to the consumer, he could not well afford to enclose the lamps in proper diffusing globes, or to remove them a good distance away from the objects he wishes to be illuminated. With the advent of the new metal-filament lamps of relatively high candle-power, the lamp could easily be removed to above the level of the eyes, or enclosed in properly diffusing globes. We should thus obtain good illumination without additional increase of expenditure.

German Railway Engineers on a Tour of Inspection.

The decision of the Prussian Government to electrify the Berlin Stadt-und-Ringbahn, has led to the appointment of a government commission to study the application of electricity to heavy electric traction conditions in this country. This commission reached this country Aug. 27 and has already visited the New York Central, New Haven and Long Island installations in New York, the Boston subway and elevated system, Schenectady, the Erie electrification, Rochester, Niagara Falls, and Pittsburg. It left Sept. 11 for Indianapolis, Fort Wayne, Chicago, Toledo, Helena and Spokane, where it will investigate the high-tension distribution system in operation there. After leaving the Pacific Coast it expects to go to Mexico and inspect the Necaxa and other high-tension transmission lines.

The chairman of the commission is Herr Geheimer Baurat Wittfeld, of the Ministry of Railways, Highways and Bridges. Associated with Mr. Wittfeld and accompanying him on the trip are Dr. Ing. Walter Reichel, professor of the Berlin Polytechnic University and formerly chief engineer of the railway department of the Siemens & Halske Company; Mr. Frederick Jordan, general manager of the Felten Guillaume-Lahmeyer works of Frankfurt; Herr Emmerich Frischmuth, engineering director of the Siemens-Schuckert Works, of Berlin, and Baumeister Phillip Pforr, manager and chief engineer of the railway department of the Allgemeine Elektricitäts Gesellschaft, of Berlin. It is proposed to divide the Prussian system to be electrified, comprising 366 miles, into two sections, one to be electrified by 1913, the other by 1920. The single-phase system with 10,000 volts on the trolley wire will probably be used.

New York Electrical Show.

The electrical show to be held in Madison Square Garden Sept. 30 to Oct. 9, inclusive, promises to be a decided success from present indications. It is announced that all of the space in the arena has been disposed of and not only will electrical manufacturing and supply companies be represented, but the New York and Brooklyn Edison Companies have also reserved space, the New York Edison Company having the largest space in the exhibit, and the Edison Electric Illuminating Company of Brooklyn the second largest.

It is the intention of the Edison Electric Illuminating Company of Brooklyn to build a five-room apartment across the Fourth Avenue end of the arena. The apartment will be furnished lavishly by a local department store company and will be modern in the extreme. Every known electrical device will be shown in operation. The apartment will comprise a kitchen, dining-room, bed room, corridor, parlor and library. Motor-driven, labor-saving devices and the usual arrangement of cooking utensils will be shown in operation in the kitchen, and the bed room will contain all the electrical devices and conveniences known. The other rooms will likewise contain electrical devices of the latest design.

The music during the show will be furnished by the Eastern Cahill Telharmonic Company, supplemented by a brass band.

A feature of the show that will doubtless appeal to the public will be the exhibit of the National Dairy Supply Company.

This company has reserved four spaces in the arena and will show a new electric milking device in operation on a herd of Jersey cows.

In the three booths on the Twenty-Seventh Street side of the main entrance a Marconi wireless telegraph station will be shown in operation. In the center aisle, facing the main entrance, will be the space of the New York Telephone Company comprising seven booths. Here will be shown a modern telephone system and, as on previous occasions, numerous telephones will be connected with the various theaters in the city, so that the performance may be heard in the Garden.

The Electric Testing Laboratories will show methods for testing lamps, cables, etc. The National Lamp Association will occupy five booths, in the main aisle, facing the entrance, where various lamps made by the companies represented in the association will be exhibited.

The General Electric Company will occupy eight booths along the main aisle, as will also the Westinghouse Electrical & Manufacturing Company. The other exhibitors are as follows: G. M. Gest, conduits; Mongul Paint Company, insulating paints; Tel-electrical Music Company, electric piano playing attachment; Lord Electric Company, lightning arresters; Federal Sign Company, electric signs; Monaton Construction Company, electric signs; Driver-Harris Wire Company, various devices showing the application of the company's resistance wire; Safety Car Heating & Lighting Company, car heating and lighting devices; India Rubber & Gutta Percha Insulating Company, insulated wires; the New York Beck Lamp Company, flaming arc lamps; Metropolitan Engineering Company, electric signs; American Wire Brush Company, electrical cleaning devices for floors, walls, etc.; the F. Alexander Manufacturing Company and Henry Fallek.

CURRENT NEWS AND NOTES.

A. I. E. E. MEETING.—The next New York City meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies' Building, on Friday, Oct. 11, at 8:15 p. m. The subject for discussion has not yet been announced.

CHEAPER WIRELESS.—A special despatch from Liverpool states that Mr. Marconi, who sailed on the steamer *Virginian*, Sept. 14, for Montreal, said before sailing that when he arrived in Canada he would install constant cheap commercial service between Canada and Great Britain. The rate from Canada to Great Britain on ordinary commercial messages would be 10 cents a word. The press charge would be 5 cents a word. The present rates are 25 and 10 cents a word respectively.

REPORTS OF RAILWAY ACCIDENTS.—The Public Service Commissioners for the State of New York not included in Greater New York have issued a circular containing regulations governing the reporting of railway accidents. Certain classes of accidents are required to be immediately reported by telegraph, including those resulting in loss of life, and accidents at grade crossings resulting in death or serious injury. Classes of accident not thus enumerated are required to be promptly reported by mail.

OHIO TELEPHONE RATES.—The advisability of legislation to fix telephone rates has become a public question in Ohio. According to Attorney General Ellis, this has been brought about largely by the fact that the long-distance companies recently increased their night-toll rates. Mr. Ellis says that he has for some time felt that the Legislature ought to take some steps toward the regulation of telephone rates, as it has the authority to do so. At present most other public service corporations are subjected to supervision in this respect, and he can see no reason why telephone companies should be allowed to be free of regulation.

TELEGRAPH STRIKE.—The telegraph strike still drags along but gives many evidences of early cessation, so far as any real effectiveness is concerned. A number of the operators have endeavored to get back their old positions, and the support from the labor unions has proved very small. The Government has refused absolutely to have anything to do with the matter, the New York Public Service Commission has declared any interference to be beyond its jurisdiction and powers, and the New York aldermen have passed a resolution favoring some kind of conciliation. President S. J. Small of the Commercial Telegraphers' Union has issued from Washington another appeal for funds from organized labor.

EDISON CONVENTION.—The annual convention of the Association of Edison Illuminating Companies was held at Hot Springs, Va., last week, when the programme already printed in these pages was carried out very successfully. There was an excellent attendance, and although as usual business was attended to very strictly, the scenery and natural attractions of the spot were also greatly enjoyed. Mr. A. Dow, of Detroit, was reelected president, Gen. G. H. Harries, of Washington, was made vice-president, and Mr. W. W. Freeman, of Brooklyn, was elected secretary. A large number of the party traveled by special car, which, after the meeting, was run to Old Point Comfort, where two days were spent with the object of seeing the Jamestown Exposition, now wearing its best aspect.

INDEPENDENT TELEPHONY IN CINCINNATI.—Mr. Phillip Fitzsimmons, of Cincinnati, is reported to have secured the necessary financial aid to construct an independent telephone system in Cincinnati, Ohio, in competition with the Cincinnati & Suburban, or Bell, Company. Recently when applying for a permit to make repairs to his present lines, permission was granted upon the condition of giving a bond for payment of a wire tax under an ordinance passed 13 years ago, the amount of the tax being $342. The charge was then made that the Bell Telephone Company had never been required to pay this tax, and that its arrearages aggregate about $500,000. This charge has been denied by the attorney of that company, who furthermore has said that since the Bell Company has placed its wires underground another company cannot legally operate an overhead system, even should it have been granted a franchise for such a system.

NEW JERSEY UTILITIES.—A bill has been introduced in the New Jersey Legislature of a public utilities commission. The measure provides for a commission of three members to be appointed by the Governor at an annual salary of $5,000 each. The commission is to have supervision over all gas, electric, light, heat, power, water, sewer, telephone, telegraph and street railway companies operating in the state, together with their plans and equipment. It will not have supervision over the railroads, this jurisdiction being held by the Railroad Commission appointed under an act of last winter. Specific authority is given to the commission to inquire into the condition and method of operating all corporations coming within the class mentioned and to investigate companies touching alleged rebates, rates, charges or demands for services rendered, and all discriminations in service rendered in the transportation of personal property or otherwise. It is authorized to make recommendations in writing to any corporation touching the improvement of its service or the betterment of its conditions and affairs. The commission is to make an annual report to the Legislature and is also to report to the Interstate Commerce Commission upon such subjects as the commission may request. The total expenses of the commission must not exceed $30,000 a year.

NEW YORK-HAVANA CABLE.—A dispatch from London states that the cable steamer, *Silvertown*, with over 1300 miles of submarine cable on board, sailed from there Sept. 12. The cable is to be laid between New York and Havana for the Commercial Cable Company. The direct cable will save much time in transmission between the two points, and will avoid the troubles to which the land lines are subject.

RADIUM CURE FOR CANCER.—In an address on "The Specific Action of Radium as a Unique Force in Therapeutics," delivered before the International Dermatological Congress, held in New York last week, Dr. Robert Abbe stated he believes that radium has solved many problems connected with the treatment of cancerous growths and other lesions. "It is possible to say positively," he said, "that cancer at a certain stage can be cured by radium. Thick, animal-like skin, covered with mouse-like hair, can be reduced by radium to a normal condition. But just how these cures are effected is a matter of conjecture."

TELEGRAPHS IN INDIA.—U. S. Consul-General W. H. Michael, of Calcutta, reports the following in regard to telegraphic messages in India: Drafts of telegrams or cablegrams filed in the Indian Telegraph Company's offices will be preserved for reference for three months. The director-general of telegraphs has addressed a letter to various chambers of commerce stating that it is under consideration to add to the number of abbreviations which can be accepted as one word, and he asked the various chambers to supply him with a list of abbreviations most commonly used to enable him to judge if any of them can be admitted. This is being done.

WORLD'S LARGEST MICA MINE.—What is claimed to be the largest mica mine in the world is located at Sydenham, Ont., 16 miles from Kingston, according to reports from Consul Van Sant. The product is mostly amber mica, with some silver amber, the highest quality mined. The mine is one mile from the upper end of Sydenham Lake, and the mica is transported in bulk from the mine by barge to the railroad at Sydenham, where it is shipped to Ottawa for trimming for the market. From Ottawa it is exported to the United States and other points. This valuable mine is owned and worked by Americans, and the output is almost entirely taken by one of the largest American electric companies.

ENGINEERING COURSES FOR EXTENSION STUDENTS.—The College of Arts and Engineering of the Polytechnic Institute of Brooklyn has arranged for the season of 1907-1908 a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing and languages especially designed to afford men in active practice opportunities for professional study. The term of study begins on Monday, Sept. 30. No formal examinations for entrance will be required of those not seeking a degree, although secondary school preparation will be assumed. The courses will be conducted by means of lectures, discussions, reports, problems and examinations. No charge is made for matriculation and examination, but a reasonable charge for laboratory use and breakage is necessary in the laboratory courses.

CONTROLLING SUBMARINE MINES.—A special telegraphic dispatch from Newport of Sept. 6 says: "Tests have been made at the torpedo station for several weeks of an invention by Henri Stenffieben, a Frenchman, of a device to render useless submarine mines planted by an enemy. The device, the nature of which has been kept secret, is understood to consist of a mechanism operated by magnetic power. The tests have been so secretly carried on that their location in the bay has not been disclosed. The inventor, who has supervised the tests, will not talk about the apparatus and the tests, but it is understood that the mines have been invariably destroyed or rendered powerless long before the vessel equipped with the apparatus has come within the zone of the explosives. The report will be sent to Washington.

MUNICIPAL FIGURING.—In his casual notes in the *M. O. Bulletin*, Mr. John Kendrick Bangs remarks: "The municipally owned electric light plant at Crawfordsville, Ind., having shown a so-called profit last year of $6,727, the trustees have just made a 10 per cent advance in the charge for street lighting. The probable reason for this is a desire on the trustees' part to increase this year's profits to an even $6,800, round figures being so much more satisfactory than angular ones." In another item he says: "One of the pleasing features of municipal ownership, as shown in New Zealand and Australia, is the luscious, juicy fatness it gives to the public debt. That of the United—sometimes called the Benighted—States is less than $12 per capita, but in New Zealand it is $335, in New South Wales, $267, and in Australia's six states it averages $291 per capita. It takes genuine prosperity to increase a nation's credit—or debit—all the way from 2200 to 2800 per cent."

INSULATING MATERIAL.—A patent issued recently to Mr. Charles L. Norton describes a method for making a new insulating material for use in the insulation of electrical apparatus. A material such as asbestiform fiber is bonded with magnesium hydrate and impregnated with an oxidizable liquid hydrocarbon such as ozocerite or mineral wax. It appears that the magnesium hydroxide combines with the hydrocarbon in such a way as to make the resulting material much harder than by other processes. The porous and refractory material employed as a base is, after ordinary drying by heat, submitted to heating in a partial vacuum and is then immersed in the liquid hydrocarbon. After drying for some days at a temperature of about 80 deg. C., the product is found to have its electric resistance, dielectric and mechanical strength many times increased, while its diminished porosity renders it non-hydroscopic; the material is also capable of a high polish and of being worked with tools.

ELECTRIC SLEEP FOR SURGICAL OPERATIONS.—A despatch from Paris states that Professor Leduc, of the School of Medicine at Nantes, has discovered a method of producing electric sleep which, it is declared, will take the place of the usual anæsthetics in surgical operations. For a human being a current with a pressure of 35 volts is applied intermittently in its full strength for minute fractions of a second. Two electrodes are applied to the skull in a special manner, the points of application being first carefully shaved. During the electric sleep the patient is perfectly quiet and the awakening occurs as soon as the electrodes are withdrawn. The sensations after the operation, it is stated, are quite agreeable. The mind appears to work more clearly and more rapidly and there is a sense of increased physical vigor. Professor Leduc incidentally asserts that the application in a certain manner of his special current will electrocute a subject, in an absolutely painless manner, gentle sleep being followed by gradual death.

FLUORESCENT ELECTRIC LAMP.—Following the discovery of the Roentgen rays, in 1896, Mr. Thomas A. Edison made a thorough study of the phenomena connected therewith, and at the time it was announced that he had invented a fluorescent electric lamp based upon the use of these rays. A patent for such a lamp has just been issued to Mr. Edison, the date of application being May 19, 1896. The lamp consists of a vacuum tube of a shape similar to that usually employed in the generation of Roentgen rays, containing two opposing electrodes with their surface at an angle with each other; crystals of tungstate of calcium are fused to the inner glass surface of the vacuum tube. When the tube is properly excited by electric current the effect of the bombardment of the molecules of the residual gas causes the tungstate to fluoresce brilliantly with a pure, white light. It is stated that a single bulb of moderate size can by this means be made to give several candle-power with a very small expenditure of energy.

GROWTH IN NEW YORK.—The growth of electrical application in New York City is both steady and rapid. The September bulletin of the New York Edison Company states that the one year up to the end of July showed a net gain of 1,000,000 16-cp equivalents, for all kinds of service. It is also noted that the suburb of Yonkers showed a gain in the year of 28 per cent.

ELECTRIC FANS IN TYPHOID.—According to advices from New England, "fan baths" are the latest remedy used by the Boston City Hospital physicians in the treatment of typhoid fever. Heretofore the ice plunge was used, and a patient whose temperature had reached the danger point was soused in a bathtub filled with broken ice until his teeth rattled. This treatment after a time was found to be too heroic, as the shock was too severe and pneumonia sometimes developed. Then ice water sponge baths were substituted, but the fan baths, the doctors declare, are just the thing. The patient is sponged off with ice water first, then a sheet that has been soaked in ice water is wrapped about the body and more ice water sprinkled on the sheet. The air from an electric fan is then turned on him so that he is chilled by the rapid evaporation caused by the breeze. The method has proved highly successful.

NIGHT TELEPHONE RATES.—An order has been issued making day and night rates the same over long distance telephone lines. This change is necessary, it is stated, on account of the practice which has grown up of making, through the day, appointment calls for 6 p. m., when the reduced rates were in effect. As people do not realize that hundreds of others are doing the same thing, they cannot understand why their service is delayed, in many cases for one or two hours beyond the appointment time, thus interfering with many engagements. It is believed that this change will take a severe and unnecessary strain off the operating force by cutting out the rush hours and distributing the traffic more evenly, and for the same reason will greatly improve the efficiency of the service to the general public. It will add something to the cost of service of some large business houses, which have built up this appointment message practice to such an extent as to make the present action absolutely necessary.

CANADIAN WIRELESS.—U. S. Consul A. F. Dickson, of Gaspé, in Quebec, makes the following report on the new wireless telegraph service between the British Isles and Canada: "The Marconi company announces that it will be prepared for wireless telegraph service between the United Kingdom and Canada in September. The messages will be transmitted between Clifton, Ireland, and Glace Bay, Nova Scotia. The regular rates will be 5 cents per word and the Government and press rates 2½ cents. Great improvements have been made lately to the station at Glace Bay, which has been moved to a more favorable situation and much enlarged. The station at Clifton has also been improved in order to meet the situation. The first stations erected were found to be too small. For some time past the Marconi company has had communication across the Atlantic and exhaustive tests have been carried on. The company has been transmitting messages from this side to England for some time, but it is only recently that the communication from England to Canada was thoroughly successful, and now that the tests have proved satisfactory the company intends entering the commercial field at once."

SAXONY WATER POWERS.—U. S. Consul J. St. John Gaffney, of Dresden, states that water power is not used to any great extent in Saxony, being entirely limited to small saw and corn mills in outlying mountainous districts. He adds: The laws relating to the development and use of water power give the right of concession to the ministry of public works. Before any concession is granted the applicant must file plans of the system proposed, buildings, etc., and power required. These plans are laid before the local technical commission, who report to the ministry. No large projects have been accepted during the last decade. The government has no water-power station in operation at present. Formerly a few turbines were in use for milling purposes on the Upper Elbe, but have been discontinued. All water-power plants at present in operation are in private hands, controlled by the government. As far as can be ascertained, there are only a few plants established, all of which develop only enough power for the needs of the mills which own them. In the absence of any figures as to water power it is impossible to make any comparison with steam power, but the former is absolutely negligible.

MUNICIPAL BONDS.—The Boston *Transcript* in a brief comment on the financial situation, after the tenor of our own recent remarks, says: "The raising of the interest rate of New York city bonds to four and a half per cent, is accepted as the inevitable sequence of new financial adjustments in the business world and as having no bearing, direct or otherwise, upon municipal credit. A similar tendency is observable, not only in Boston and other American cities, but in the leading money centers of Europe as well. But attention is called to another aspect of the situation, its probable effect upon the municipal ownership movement. One of the pivotal points in the arguments of the advocates of municipal ownership has been the cheapness with which cities could borrow money. Two years ago, one of the leading spellbinders made this assumption practically fundamental. The existing companies, gas, electric, transportation or what not, were to be bought out or forced to compete with rival plants, built with municipal funds, which, it was contended, could be obtained in any amounts at a rate not exceeding three and a half per cent at the utmost. That was only two years ago. Yet for some months we have seen four per cent suppliants on the market with few takers, and the additional half per cent was inevitable. But this will compel the municipal ownership people to revise their line of reasoning. Their old figures are no longer of service. On the basis of their own former claims they are now put on the defensive by hard and stubborn facts. Sentiment does not govern in the issue of city bonds. They must conform to the same economic law that governs all the other bond issues.

TELEGRAPHS IN CANADA.—With regard to the telegraph strike in the United States, it is pointed out that such wanton interruption of service is not possible in Canada. By the general Dominion Act incorporating telegraph companies, they are required to dispatch messages in the order in which they are received without delay. A telegraph company that should detain messages a week before forwarding them would scarcely be held to have fulfilled the law because in finally sending them it adhered to the sequence in which the messages had been presented to it. Irrespective of the force of relevant conditions in its special Act, the company would doubtless be found to have violated the section of the general Act relating to the order in which messages are to be transmitted. But the will of Parliament that the telegraphic service must be maintained as far as possible without interruption is expressed in a more recent statute passed last session known as the Lemieux Act. This measure takes from employees engaged in certain occupations the liberty of striking and deprives the corresponding employers of the right to lock out their men. Before a labor dispute can produce a cessation of work the differing parties are bound to ask for the mediation of a board of conciliators. Only after the board has failed to restore a good understanding between employees and employers is it allowable for a strike or a lockout to be resorted to. Telegraphy is one of the departments of activity covered by some of the prohibitions of the Act. If telegraphers strike before steps are taken to have their grievance submitted to a Board of Conciliation, each striker is liable to a fine of not less than $10 and not more than $50 for each day he is out on strike. If any employer of telegraphers locks them out he shall be liable to a fine of not less than $100 nor more than $1,000 for each day of the lock-out.

The Plans of the Bar Harbor and Union River Power Company.

AN important hydro-electric equipment is now being installed at Ellsworth, Me., by the Bar Harbor & Union River Power Company, headed by John R. Graham, Esq., of Bangor, president and general manager of the Bangor Railway, Light & Power Company. The fall of the Union River at Ellsworth is unusually favorable for an extended development for hydro-electric transmission, and the accompanying photographs, together with the power house drawings reproduced herewith, show clearly the general scope of the work. Messrs. Sellers and Rippey, of Philadelphia, are the consulting engineers for the undertaking, which is supervised by Mr. J. A. Leonard, resident engineer of the Bar Harbor & Union River Power Company.

Electricity is to be transmitted to the electric railway and lighting system of Bangor from Ellsworth by a 25-mile, 33,000-volt transmission line connecting the Ellsworth power house with the Bangor Railway & Electric Company's hydro-electric plant on the Penobscot River in the town of Veazie, near Bangor. The line will, at first, consist of a three-phase circuit equivalent in conductivity to No. 3 copper. It has not been decided whether to use copper, aluminum or steel conductors for this service. The company has been experimenting with both iron and steel wire in view of the present high price of copper, but so far the results secured have simply been extensive enough to debar the use of iron. Electricity will also be transmitted to Mt. Desert Island for central-station service and Mt. Desert Transit Company, a railway being built between Ellsworth and Bar Harbor, Maine, and delivered locally at about 33,000 volts to a lighting station in Bar Harbor. The length of the line from Ellsworth to Bar Harbor will be 24 miles. The pole lines will be arranged for two circuits each, with Locke insulators. At Bar Harbor there is now a 1000-hp steam plant which will be held as a reserve.

To pass from the mainland to Mt. Desert Island across the narrow channel between the two, two spans 850 ft. long will be required in order to give the clearance above the water demanded by the War Department. These spans will be supported by steel towers 140 ft. in height. There will also be a span of 850 ft. between steel towers across the Penobscot River between Eddington and Veazie on the Bangor line. The Bar Harbor station will at first be equipped with three 400-kw, 19,600-34,000-volt primary star connected, 2490-1920-volt, secondary water-cooled General Electric single-phase transformers with controlling switchboards. At Veazie there will be three 500-kw single-phase transformers of the same make, with secondaries wound for 7900 or 6450 volts. Step-up transformers at Ellsworth will consist of three 500-kw, three-phase units with 2300-volt primaries and 19,600 or 34,000-volt secondaries. The switchboard here will have capacity to control two 1500-kw outgoing, three-phase lines.

The power house at Ellsworth will be a concrete block structure with red Spanish tile roof. It will be supplied with water through a canal 75 ft. wide, 20 ft. deep and 180 ft. long leading to a forebay 95 ft. long, 76 ft. wide and 20 ft. deep above the power house on its west side. The river is now being damned at the power house site by a reinforced concrete dam 71 ft. high, 100 ft. wide at the base, 8 ft. wide at the top and with a 300-ft. length spillway. The dam is to be hollow inside and is of the familiar type built by the Ambursen Hydraulic Construction Company, of Boston, Mass., who is the contractor for this part of the work. The plans provide for the construction of a future storage reservoir 1.5 miles above Ellsworth, which will be 20 miles long and 3 miles wide, with a 300-ft. dam, 60 ft. high. The total flow of the river with the storage developed is figured at 825 cu. ft. per second, giving an ultimate power of 6000 horse-power for 24 hours, or 12,000 horse-power for 12 hours. The present development provides for about 2500 horse-power.

The dimensions of the power house at first will be 50 ft. x 70 ft. Coarse racks will be provided at the forebay entrance, and above these will be a foot and cable bridge which will connect the power house with a transformer building about 20 ft. x 80 ft. At the south end of the transformer house will be a tower for high tension lines, which will provide for the issuance of the overhead circuits at a height of about 35 ft. above the ground. At the south end of the forebay will be a temporary spillway and on the east side a gate house which will control the water in the penstocks leading downward into the power plant. Additional racks will be installed at the penstock entrance. The head at the water wheels will be 60 ft. The first installation provides for a 1000-kw generator and one of 500 kilowatt rating, both being General Electric, revolving-field 2300,volt, three-phase, 60-cycle alternators. Sixty cycles is the frequency adopted for the entire system because the old plants at Veazie and Bar Harbor operate at this frequency. The speeds are 277 and 400 r. p. m. respectively. The turbines are to be of S. Morgan Smith make, rated at 1700 horse-power and 850 horse-power respectively. The intention is later to substitute a 1000 kilowatt unit for the 500-kw machine, and to reduce the cost of reconstruction. The 850 horse-power outfit will be provided with a wheel casing and draft tube for 1700 horse-power. Two 75-kw, 125-volt exciters will also be installed.

Each of the main generating units will be supplied with water through a penstock 8 ft. in diameter, which will connect the wheel casings and the forebay by a straight run with two 45-degree bends at the top and bottom. As indicated, each turbine will be provided with a draft tube. The penstocks will be 21 ft. apart on centers. The exciters will be served by a penstock 3 ft. in diameter, with provision for a second of the same size, 3 ft. 6 ins. distant on centers when the expansion of the

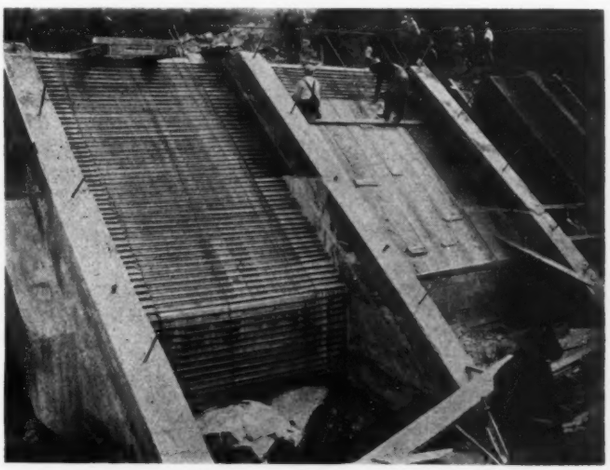


FIG. 1.—REINFORCING STEEL FOR DECK, IN PLACE.

FIG. 2.—WEST SIDE OF RIVER, LOOKING UP-STREAM.

plant warrants it. Four governors will be provided by the Ludlow Valve Manufacturing Company. The switchboard of the plant will be mounted on a gallery commanding a view of the entire generating room. All the units will be direct-coupled to their prime movers. Local lighting service in Ellsworth will be handled by constant-current transformers and regulators located on the gallery. The turbine room will be served by a 15-ton Niles electric crane with hand attachment. The exciter turbines will consist of 125-hp machines making 550 r. p. m., The 2300-volt current from the generator will be carried across the forebay bridge to the transformer house by a cable duct, thus freeing the power house from high-tension line current. An interesting feature of the power house and dam construction is the utilization of the space between the buttresses nearest the power house for machine shop, storage, heating and toilet rooms. The hollow character of the dam permits free passage through it and stairways are provided at each end of the dam to facilitate this. Three sluice pipes are also carried under the dam between buttresses with controlling valves at the foot of the stairways. The power house can be extended indefinitely toward the south by removing the temporary spillway at the end of the station and excavating further in the direction of the town. The columns, roof trusses and rock supports were supplied by the Berlin Construction Company, of Berlin, Conn.

The Veazie power plant has a total capacity of about 2200 horse-power, and is one of the oldest hydro-electric plants in the country. There is also at this plant an auxiliary steam equipment aggregating 1800 horse-power. Upwards of 40,000 incandescent lamps are now on the circuits of the Bangor company, or more than one 16 candle-power unit per inhabitant. For manufacturing purposes about 600 horse-power for motors is supplied to 140 consumers, the motors ranging from ¼-hp to 30-hp in size. The company operates 60 miles of trolley lines, and last year handled 4,114,715 revenue passengers with a total car mileage of 990,000. Municipal lighting in Bangor is supplied by the city itself from a power plant located at the water works dam within the city limits. The Penobscot River drains about 8000 square miles of territory.

Local distribution in Bangor is effected at a new sub-station on Park Street, near the center of the business district. The railway load is handled by two 500-kw, 60-cycle, 360-600-volt rotaries of General Electric make supplied by two banks of transformers of 185 kilowatts, each unit being of the oil-cooled type. The electric supply from Veazie is transmitted over five three-phase No. 0 circuits, 4.5 miles long. An auxiliary to the railway service is a battery of 270 cells of the Electric Storage Battery Company's make, which is floated on the direct-current sub-station bus-bars without the use of a booster. The sub-station contains 480 kilowatts of lighting transformers with star-connected secondaries, 6050-volt, primaries and 2110-volt low-tension sides. Separate bus-bars for lighting and railway service are in use at Veazie. In Bangor the lighting distribution is four-wire, the neutral of the star being brought out. Each service transformer (normally 2080 volts) is connected between the neutral and one of the three-phase legs. The lighting switchboard contains seven marble panels. Motor service is handled by 240 kilowatts of transformer capacity, distributing at 575-volt, three-phase around Bangor.

FIG. 4.—NORTH FOUNDATION WALL OF POWER HOUSE.

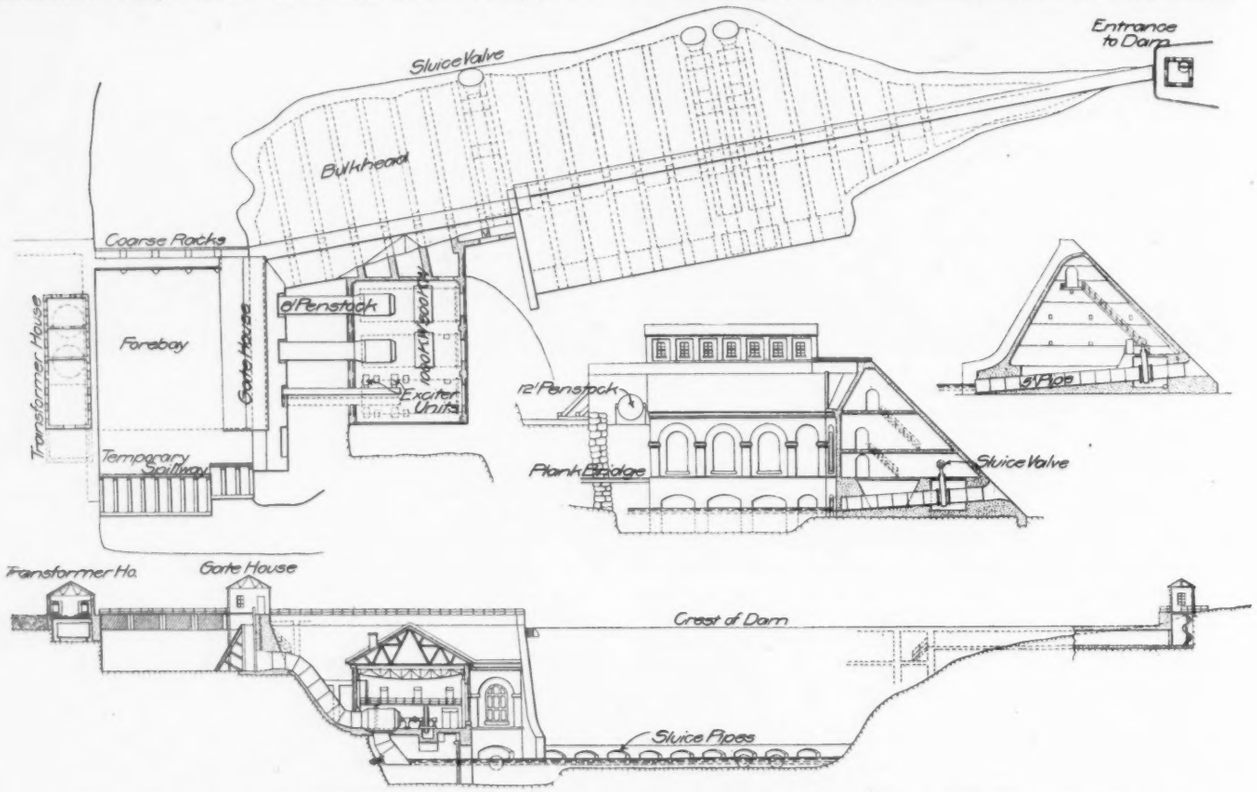


FIG. 3.—PLAN VIEW AND ELEVATIONS OF DAM AND POWER HOUSE OF THE BAR HARBOR AND UNION RIVER POWER COMPANY.

The Design of Plunger Magnets.

BY C. P. NACHOD.

IN an iron-clad stopped plunger magnet of the type of Fig. 1, having specified external dimensions and stroke, and in which the coil is to operate under a specified temperature rise, the proportion of copper and iron in the coil and core may be varied between the limits from all copper and no iron to no copper and all iron, at both of which extremes the pull between the iron plunger and magnetic core will be zero. It is evident, therefore, that there is some intermediate proportion where the pull is a maximum. It is the object of this article to show the relation between the pull and the diameter of the plunger under the above-mentioned conditions, and incidentally to show also such other properties of the magnets as number of layers, resistance, current, ampere-turns, and volts, corresponding to the various diameters of plungers.

In the symbols below capital letters refer to the constants imposed by the above-mentioned conditions, and small letters to variable quantities.

Let W, r, i, be the watts, resistance and current, respectively, in the coil. Then

$$i^2 = \frac{W}{r} = \frac{56.25}{r} \qquad (1)$$

Since the coils have the same outside diameter and length, and, therefore, present the same exterior radiating surface, if the heat conducted away by the core is neglected, the condition of constant temperature is that of constant watts absorbed. The value of 56.25 watts has been taken for a coil of 2¾ ins. outside diameter, 2 1/16 ins. long, or .317 sq. in. per watt, which figure has been found safe under the conditions of oil cooling used.

The resistance of the coil is proportional to its mean diameter and to the number of layers. Let r = hot resistance of coil, d_m = mean diameter of winding in inches, s = number of layers. Then

$$r = K d_m s = 2.235\, d_m s \qquad (2)$$

where k = constant of proportionality, equal to 2.235, as found by experiment with No. 28 single cotton-covered wire, which is assumed for all the coils.

By inspection of Fig. 1

$$d_m = d + 2C + As = d + \frac{1}{4} + .01562\, s \qquad (3)$$

where d = diameter of plunger, $C = \frac{1}{8}$ in. radial clearance between outside of iron plunger and inside of winding. A = thickness of a layer as measured on a radius of the coil = .01562 in. as found by experiment with No. 28 s. c. c. wire, or about 95 per cent of the nominal insulated diameter of the wire. This is probably due to the bedding of the wire.

The outside diameter D, 2¾ ins., is seen by inspection of Fig. 1 to be

$$D = 2As + 2C + d \text{ or } 2\tfrac{3}{4} = .03124\, s + \frac{1}{4} + d \qquad (4)$$

$$n = Ts = 114\, s \qquad (5)$$

n being the total turns, and $T = 114$, the turns per layer.

In the c. g. s. system, the fundamental formulas for magnetic pull p, and magnetizing force H, are

$$p = \frac{B^2 A}{8\pi} \text{ and } HL = \frac{4\pi ni}{10}$$

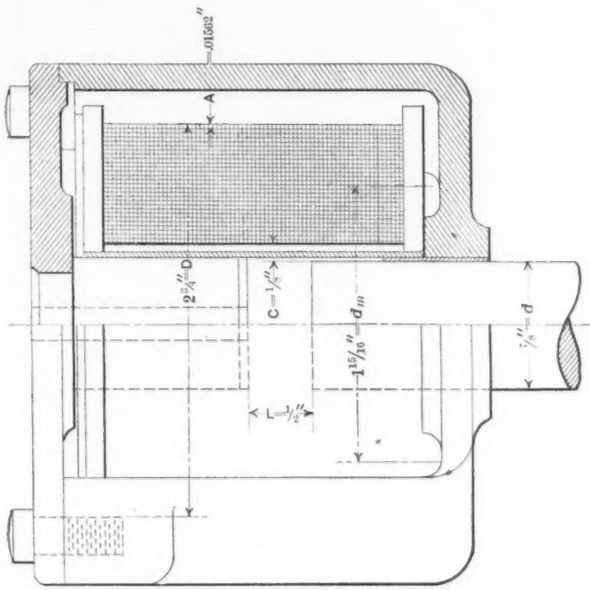


FIG. 1.—IRON-CLAD STOPPED PLUNGER MAGNET.

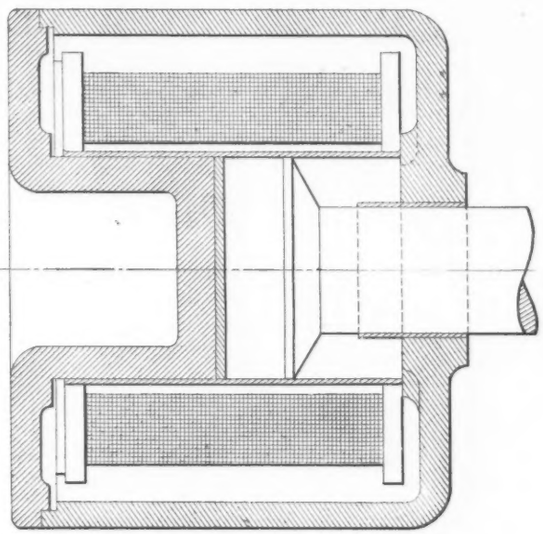


FIG. 2.—MAGNET WITH 1.5-IN. PLUNGER.

In the air-gap $B = H$, and the area A for the cylindrical plunger is $\frac{\pi}{4} d^2$. Making these substitutions and converting to pounds and inches, there results for the initial pull

$$p = \left(\frac{ni}{2660\, L}\right)^2 \frac{\pi d^2}{4} = \left(\frac{ni}{1330}\right)^2 .7854\, d^2 \qquad (6)$$

where ni is the ampere-turns and L the length of air-gap, ½ in.

From equations 1 to 6 inclusive, it is now possible to express the pull in terms of the foregoing constants, and the diameter of plunger as the independent variable. Performing these eliminations there results

$$p = \frac{Md^2 (Q-d)}{N+d} = \frac{9.3\, d^2 (2.5-d)}{3+d} \qquad (7)$$

where M, Q, N, are compound constants used for abbreviation, and have the following values:

$$M = \left(\frac{T}{2660\, L}\right)^2 \frac{\pi W}{4KA} = \left(\frac{114}{2660 \times .5}\right)^2 \frac{.7854 \times 56.25}{2.235 \times .01562} = 9.3 \qquad (8)$$

$$N = D + 2C = 2\tfrac{3}{4} + \tfrac{1}{4} = 3 \qquad (9)$$

$$Q = D - 2C = 2\tfrac{3}{4} - \tfrac{1}{4} = 2.5 \qquad (10)$$

To find the diameter which gives the maximum pull, the first

derivative of p with respect to d has been formed and equated to zero, the solution of the resulting quadratic yielding

$$d = \frac{3N-Q}{4} \pm \sqrt{\left(\frac{3N-Q}{4}\right)^2 + NQ} \qquad (11)$$

$$d = \frac{-D-4C+\sqrt{5D^2+8CD}}{2} = 1.56 \text{ in.} \qquad (12)$$

From the form of d in equation (12), it will be seen that the diameter of plunger for maximum pull is independent of all other constants except the outside diameter of coil, and the clearance between plunger and coil. If this clearance C equals zero, an impractical but ideal condition, there results

$$d = \frac{\sqrt{5}-1}{2} D = .618\, D = 1.697 \text{ in.} \qquad (13)$$

In the interpretation of equation (7) the diameter of the plunger is conceived increasing from zero as the pull is observed, the iron plunger swelling at the expense of the copper until it reaches the outside diameter of the latter, the current

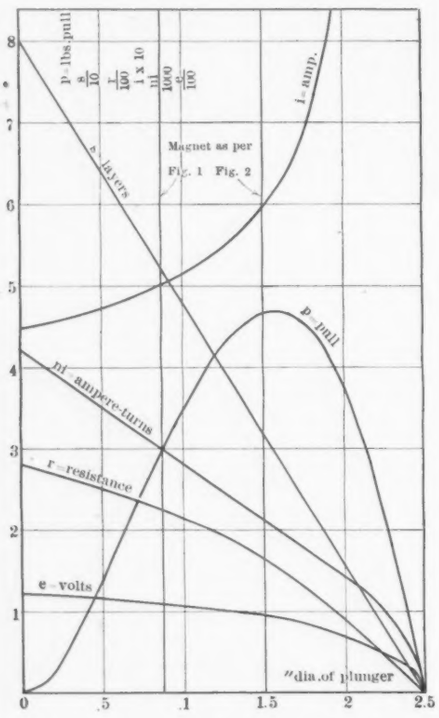


FIG. 3.—CURVES OF MAGNET DESIGN.

and resistance meanwhile changing so as to keep the watts, and, consequently, the temperature, constant.

The form of the curve p in Fig. 3 shows that for each value of the initial pull there are two magnets conforming to the conditions named that will produce it.

The other properties of the coils are given below in the equations (14-18), derived from equations (1-5) inclusive—both in their general and specific forms. Equations (14-18) are plotted in Fig. 3 against the common absicissa, diameter of plunger d.

$$s = \frac{D-2C-d}{2A} = \frac{2.5-d}{.03124} \qquad (14)$$

$$r = \frac{K}{4A}(D^2-4C^2-4Cd-d^2) = 17.9\,(15-d-2d^2) \qquad (15)$$

$$i = 2\sqrt{\frac{AW}{K(D^2-4C^2-4Cd-d^2)}} = 1.773\sqrt{\frac{1}{15-d-2d^2}} \qquad (16)$$

$$ni = T\sqrt{\frac{W(D-2C-d)}{AK(D+2C+d)}} = 4570\sqrt{\frac{2.5-d}{3+d}} \qquad (17)$$

$$e = \sqrt{Wr} = 31.7\sqrt{15-d-2d^2} \qquad (18)$$

e being the volts on the coil.

Of these curves the resistance, ampere-turns, volts and layers have their greatest values, and the current the least, for $d = 0$; while for $d = 2.5$ all these quantities are zero except the current, which is infinite. The maximum pull occurs with a plunger 56.7 per cent of the outside diameter of the coil under the particular conditions assumed.

Figs. 1 and 2, drawn to scale, show a comparison between the magnet actually constructed and the one producing the maximum pull. By reading from the curves it may be seen that the former, having a plunger .875 in. diameter, has 52 layers, .5 ampere, 225 ohms, 112.5 volts, 2960 ampere-turns, and produces a pull of 2.96 lbs.; and that the latter, having a plunger diameter of 1½ ins., has 32 layers, .591 ampere, 161 ohms, 95 volts, 2155 ampere-turns, and produces a maximum pull of 4.64 lbs. That is, an increase from ⅞ in. to 1½ in. plunger diameter increases the pull 57 per cent, decreases the ampere turns 27 per cent, and the resistance or the weight of copper, 40 per cent.

Other things than the maximum pull, however, enter into practical consideration; and the magnet of Fig. 1, besides being of the simpler mechanical design, has smaller inertia, which will facilitate rapid action. The magnetic leakage is less in Fig. 1 than Fig. 2, as the m. m. f. is greater, and the return iron path further from the core.

The reluctance of the invariable air-gap has not been considered in the above discussion. It is, however, relatively small on account of its greater area and shorter length, though great enough to be taken into consideration.

Equation 6 is based on the assumption that the reluctance of the iron is negligible in comparison with that of the air-gap, but as only low densities are employed at the beginning of the stroke, this amount is insensible, though the error increases as the plunger diameter decreases.

It is not necessary that the pull increase greatly, as the plunger moves to the stop and this explains the cutting away of superfluous iron in Fig. 2.

Distortion in Telephonic Transmission.

By Louis Cohen.

THE most important factor to be considered in telephonic transmission is distortion; every telephone engineer appreciates this fact, especially so when it is a question of long-distance telephony. The cause of the distortion arises from the fact that an electric wave in its passage along a conductor is attenuated, and the attenuation is a function of the frequency, so that every harmonic is attenuated to a different degree and the speech wave is distorted. The distortion, of course, becomes more pronounced as the length of circuit increases.

This subject, which is of great importance in telephony, has been investigated by a number of scientists and engineers, notably among them Mr. Oliver Heaviside and Prof. M. I. Pupin, yet there is one vital point in connection with this subject which, to my knowledge, was entirely overlooked by the preceding investigators.

If we denote the inductance per unit length of line by L, its capacity by C, and its resistance by R, then the attenuation constant β will be as follows:*

$$\beta = \sqrt{\tfrac{1}{2}}\sqrt{\omega C\left\{\sqrt{\omega^2L^2+R^2}-\omega L\right\}}$$

Now all previous investigators assumed, at least by inference, that the constants of the line are the same for all frequencies,

*For the derivation of this expression see my paper on "Inductive Disturbances in Telephone Lines," Proceedings American Institute of Electrical Engineers, May, 1907.

and the only variable in the expression of β is ω. If this is so, then in the case of a long line, say, the line from New York to Chicago, the constants of the line are approximately as follows:

a (radius of wire) $= 0.2$ cm
$L = .004$ henry per mile
$R = 2$ ohms per mile
$C = .01$ microfarads per mile.

Using these constants in the above expression of β, the values of β for various frequencies will be given in the following table:

$\omega = 2\pi \times$ frequency.	β	$\epsilon^{-\beta l}$ ($l = 500$ miles)
1,000	15.36×10^{-4}	0.4639
3,000	15.76×10^{-4}	0.4548
6,000	15.80×10^{-4}	0.4540
9,000	15.806×10^{-4}	0.4538
12,000	15.808×10^{-4}	0.4538

Now the column under $\epsilon^{-\beta l}$ gives the fraction of the sending current that reaches the end of the line, and from this table it will be seen that difference in the attenuation for these frequencies, which are about the range of telephonic frequencies, is not so large as to introduce any distortion; the difference in the attenuation for a frequency of 500 and 2000 is only about one-fifth of a per cent, which is hardly appreciable, and it thus seems reasonable to conclude that on the assumption that the constants of the line are independent of frequency we ought not to have any distortion. Since, however, we know that distortion does take place in telephonic transmission, the question naturally suggests itself: What is the cause of distortion? And I submit the following explanation: In passing an alternating current through a conductor the resistance will vary with the frequency, increasing as the frequency increases. The resistance of a straight cylindrical conductor for alternating currents is given by the following formula:

$$R = R_0\left(1 + \frac{1}{12}\,\frac{\omega^2 \mu^2 \pi^2 a^4}{\sigma^2} + \ldots\ldots\right)$$

where

R_0 denotes the resistance of conductor for direct current
ω " $2\pi_x$ frequency
μ " permeability
a " radius of conductor.
σ " specific resistance.

Calculating the resistance of the line by the above formula, the values of the resistance for various frequencies will be as follows:

$\omega = 2\pi \times$ frequency.	R.
1,000	2.00096
3,000	2.00864
6,000	2.03456
9,000	2.07902
12,000	2.13824

Introducing the above values of R in the expression for β,

ω	β	$\epsilon^{-\beta l}$ ($l = 500$ miles)
1,000	15.37×10^{-4}	0.4637
3,000	15.82×10^{-4}	0.4538
6,000	16.07×10^{-4}	0.4478
9,000	16.39×10^{-4}	0.4404
12,000	16.9×10^{-4}	0.4296

From this table it will be seen that the difference in the extent to which the different components were attenuated is decidedly more pronounced than in the previous case when the change of resistance was neglected. In fact, in this case the difference in attenuation between a frequency of 200 and 2000 will be about 7 per cent, which may cause considerable trouble. It is to be noticed also that the inductance diminishes somewhat with the frequency, but it is so slight that it may be neglected. The above consideration would naturally suggest the use of stranded wire for long-distance telephony, for the change in resistance varies as the fourth power of the radius, and consequently by diminishing the radius we diminish the change in resistance, which according to the theory developed here is the cause of nearly all the trouble.

It may be of some interest in connection with this subject to consider the Heaviside distortionless circuit. Mr. Heaviside has pointed out in a number of his papers that if a certain relation, which we will give presently, obtains between the constants of the line then all distortion will be eliminated. If we take into consideration the leakage constant of the line, and follow the same method of deduction as that given in my paper referred to above, we shall obtain the following value for the attenuation constant:

$$\beta = \sqrt{\frac{1}{2}}\sqrt{-(CL\omega^2 - KR + \sqrt{(CL\omega^2 - KR)^2 + \omega^2(RC + KL)^2}}$$

where K denotes the coefficient of leakage.

If we adjust the constants of the line so that $\frac{R}{L} = \frac{K}{C}$, then the above expression of β will become

$$\beta = \sqrt{KR}$$

which is independent of the frequency. Mr. Heaviside deduced his results in an entirely different manner, but the result obtained is the same, and he repeatedly calls attention to the fact that when the constants of the line are so arranged that $\frac{R}{L} = \frac{K}{C}$ then we shall have a distortionless circuit. Now, this would be perfectly true if the resistance of the line were independent of the frequency, but I maintain that the resistance is different for the different frequencies; in fact, this is the cause of nearly all the trouble, and therefore even if it were possible to realize in practice the above relation between the constants, we shall still have distortion, since β is a function of R, and R varies with the frequency.

Canadian Electrical Association Convention.

The seventeenth annual convention of the Canadian Electrical Association was called to order at the Canadian Society of Civil Engineers' building, in Montreal, at 10:45 a. m., Sept. 11, with President R. G. Block in the chair. The minutes of the previous meeting were first read, after which the president's address was delivered. This consisted of a résumé of the last year's progress in energy transmission from Niagara Falls, the place of the 1906 meeting, and running comments on the general bearing of high-tension commercial distribution and the needs of the central-station industry with reference to future conditions. Attacks on vested rights have been very severe during the past year, but it is believed that saner counsels are prevailing in the public mind and that the duplication by the government of existing private investment is less of a danger than a short time ago. On the part of certain unthinking persons there arose a cry that Niagara power should be as free as air, but there is no more reason why it should be freer than ice or gold, which anyone is at liberty to harvest or dig for himself and order brought at his door in unlimited amounts free of charge! If rates are to be lower the entire existing investment in power-plant equipment must be utilized.

Transmission lines of the very high potential type do not lend themselves readily to distribution in scattered areas, small towns and sparsely populated centers. It is possible that the Thury direct-current system may be pressed into service for this work, giving plants and towns far away from Niagara the benefits of cheap energy. President Block urged the need of studying winter and summer load curves in small centers, and stated that a flat rate based on the maximum demand would probably be the best solution of the cost of supply question. Care must be taken not to increase the capital expenditure for the sake of handling peak loads. Underground distribution is almost certain to become more general, and a single system must meet all the service needs. The use of more efficient lamps is liable to cut down the revenue of the companies by one-third to two-thirds, and new uses of electric motors, extension of heating loads, sign lighting, general lighting, and even increasing the distribution voltage will have to be considered

as offsets to customers' equipment economies, high cost of copper and high operating expenses. The report of the secretary and treasurer, Mr. T. S. Young, was then read and a total membership of 320 chronicled, an increase of ninety over the preceding year.

Mr. A. B. Lambe, of the Canadian General Electric Company, then read a paper on "Electric Heating and Cooking Devices." He discussed the peculiar physical characteristics of heating apparatus, described the salient construction features of representative equipment and outlined the best methods of attacking the commercial problem of placing heating apparatus in customers' homes. The flat-iron is the best device to introduce first by actual demonstration and free trial in the residence. A report from a commercial laundry using electric irons stated that 20 per cent more work can be done by electric heat and all the work is of one lustre and finish. In another instance 30 per cent more work per operator could be performed. Convenience and cleanliness outweigh the cost of operation, including the greater safety of the electric heater.

A fair average of the energy consumption for cooking a complete electric meal per person is 300 watt-hours, amounting to $10.80 per month at an 8-cent rate per kw-hour, or $6.75 per month on a 5-cent rate. To compete in heating with coal at $7 per ton the rate must be 5 or 6 cents per kw-hour, and to compete with gas at $1 per 1000 cu. ft, the rate must be 3 cents. Lighting companies should exploit heating devices, leaving the regular sales later to the supply house. The cost of flat-irons is medium and the consumption of energy reasonable. Small heating devices are usually charged on lighting rates, but larger units can be given lower rates on a separate meter; heating rates, for example, are 5 cents in Jackson, Mich.; 3 cents in Hartford, Conn.; 5 cents in Schenectady and Montreal, and 2 cents in Sault Ste. Marie, where the distribution is close to the generating plant. In 1906 the central station company in Cleveland put in 1200 heating devices; it now installs 120 per month and demonstrates only on complete electric cooking outfits. Montpelier, Vt.; Massillon, Ohio, and Rochester, N. Y., peculiarly a gas city, with only some 700 houses wired, have been particularly good flat-iron and electric-heating fields. Los Angeles has 10,000 irons, and Spokane gave an electric flat-iron as a bonus for getting newspaper subscriptions. The increase of the day load is a special advantage to the companies.

In the discussion it was emphasized that more revenue should be obtained from that portion of the plant which is idle a considerable part of the time. The defects of electric heater practice were outlined as high maintenance charges unless used with skill, liability to burn out, as in the case of a motor heater used to heat thick and heavy liquids, like wax, and the failure of many companies to advise their customers how to select and use the apparatus to best advantage. The luminous type of heater is being used to great advantage in England, and there is no question that the light adds to the selling power of the device. It is important to show the public that on heavy goods a heavy iron must be used, and a light iron on light goods.

In the afternoon session two papers were read. The first was by Mr. M. A. Sammett, of the Montreal Light, Heat & Power Company, on "Trials of the Operating Man." Mr. Sammett emphasized the need of additional work in lightning protection, and urged liberality in plant design. There is no need of installing units which will carry continuously 50 per cent overload at moderate temperatures. What is essential is that the apparatus should be capable, under emergency conditions, to carry 25 or 50 per cent overload for a specified interval. The problem of maximum permissible units to be most advantageous under given conditions of operation is becoming prominent in power-house economy. This results usually in larger capacity units and involves artificial cooling. The operating man should be fully aware of the time at his disposal for safe running of his machine under overload conditions or under conditions of no artificial cooling. A curve of temperature at overloads should be used as a gauge in emergencies.

To improve the receiving voltage it is only necessary to increase the voltage of the generator, but increased voltage means increased iron loss in the armature laminations, a larger field current and higher temperatures. In transformers an increased voltage means higher temperatures. The safety of increasing the voltage by 10 or 15 per cent to compensate for increased line drop can only be determined after the study of each particular machine. In the case of a 3750-kw generator the core-loss curve showed that an increase of 10 per cent in the generator voltage is equivalent to an additional loss of 18 kilowatts. This loss is so much heat added to the body of the armature, and the corresponding temperature increase resulted in 55 deg. C., giving a maximum of 41.5 deg. C. No difficulty should be anticipated from the above increase in voltage on the ground of increased potential between turns and layers of winding or from increased strain to ground.

With proper adjustment of prime movers the generator will divide the load proportionally. In this respect they are more under control than some of the less complicated apparatus, like transformers. Over and under excitation of the generators will cause a flow of circulating currents between them. The adjustment of the field currents remedies this, and the use of power-factor meters on each machine is of considerable assistance. To prevent unequal loading of transformers the primary and secondary voltages must be the same and the impedances equal. The characteristics determining the division of load must be known under actual conditions of operation. In one case when a bank of transformers was connected in service during the pressure of a heavy Christmas load, the bank burned out on account of overload in a few days after installation. Time could not be spared to test transformers for impedance. They were connected in parallel on high and low tension windings on the strength of the manufacturer's guarantee. A test subsequently made on two spare transformers supplied on the same order as those that burned out revealed the fact that the new transformers had an impedance of 3.58 ohms, while the old transformers had 4.4 per cent, and so the new bank carried an overload of 19 per cent. With transformers the suitability for proper parallel operation must be verified, and if they will not divide the load proportionately to their capacities, corrective reactances must be added to equalize them in this respect.

Air-blast transformers accumulate dust readily, which is objectionable on moderate voltages between 15,000 and 22,000. The temperature of the upper portions of the coils is often much in excess of the average winding temperature. Whenever transformer coils are connected on top, the air passages are frequently blocked and the temperatures reach a danger point. Unless compressed air is perfectly dry it may damage the insulation in blowing out and cause a burnout. Another trial is to the ease with which flames are carried from one transformer to the other through the air-chamber. With the oil-insulated, water-cooled transformer many of these defects are absent. Less insulation thickness enables larger ducts to be used and the temperature of the coils with ample oil insulation are more uniform. The main argument in favor of oil-insulated, water-cooled transformers is their ability to withstand excessive overloads, and their immunity from breaking down at temperatures even as high as 200 deg. C. In a case of this character the temperature was reached under abnormal conditions of phase transformation. One unit ran at 72 deg. C. and the other at 200 deg. C., the room being 42 deg. C. The trouble was discovered when an inspection of the transformer installation was made. A thermometer of 150 deg. C. range was found with a broken bulb when left in the oil, and a long-range instrument showed 200 deg. C. When brought into the testing department the transformer was given an insulation test of 10,000 volts from primary to secondary and ground; also from secondary to ground of 500 volts, which it stood successfully. Double voltage was applied across transformer terminals and the insulation stood the test. The rating of the unit was 24 kilowatt, 60 cycle, 2000-550 volts. A great advantage of the oil-insulated transformer is the higher effectiveness of

insulation to resist induced high voltages, either through switching or through lightning disturbances. The fear of oil in the transformer as a fire risk is a matter of the past. Instances of stations destroyed by fire when oil-insulated apparatus such as transformers and regulators were the only machines saved. show the fallacy of opposing oil-insulated apparatus. Oil will also extinguish the arc resulting from a short circuit in the transformer and prevent the burning of the insulating fabrics, thus doing away with smoke filling the station, which is always the case with air-blast apparatus. The two main drawbacks of oil-insulated, water-cooled transformers are the possibility of water getting into the winding and the breaking up of the oil, forming a thick non-conducting mass.

A water coil capable of withstanding 200 lbs. hydrostatic pressure and proper connection of the coil to outside piping will guard against the former difficulty, while care exercised to remove the water from the coils by an air-pump or by filling it with oil under pressure will guard against freezing. The breaking up of the oil takes place only at high temperatures. In one case a sample of oil subjected to a temperature of 90 deg. C. formed a heavy deposit in two weeks. It is inadvisable to allow transformers to reach a temperature in excess of 70 deg. C.

It sometimes happens that through no apparent reason the temperatures begin to rise. The cause may be due to either the iron ageing, with higher iron loss, to breaking up of the oil, or clogging of the water-cooling coils. In one instance where water was carried to the brass cooling coils through an iron pipe the acidulated water passing through the iron pipe attacked the iron and then going through the brass tubes deposited the iron in the form of a sediment which reduced the coil opening to one-third its normal size; hence the rise in temperature.

A brief discussion followed Mr. Sammett's paper. It was pointed out that many transformers are injured by careless handling after they have been in service, and there was general agreement that the oil-insulated transformer is a good fire risk. Current transformers with split cores are desirable for testing. The importance of bunching transformers close together on the same load was illustrated by a case in which four 25-kw transformers were located on two poles 50 ft. apart outside a building, one pair being that much nearer the load. The nearer pair ran at 100 per cent overload and the farther pair at 80 per cent load. The trouble was remedied by adding two more units and locating all six close together.

The next paper was by Mr. B. T. McCormick, of the Allis-Chalmers-Bullock Company, on "Three Wire Questions." The paper dealt mainly with the general electrical principles involved. Probably the most efficient three-wire outfits consist of a generator provided with a two-phase combination of balancing transformers, in which the center laps are tied together and the neutral wire joined to the point of connection. Two pairs of slip rings are used, connected to taps in the armature winding, situated 90 electrical degrees apart. Such a combination results in a more even current distribution in the armature than can be secured by the use of a single transformer. The cost of the balancing transformer is a very small portion of the total cost of the apparatus. Ordinarily an allowance of 25 per cent unbalancing is sufficient, which would mean a 22-kw transformer of the two-phase combination of coils for a 100-kw, 250-volt machine. If shunt-wound, the generator differs from standard generators only by the addition of slip rings, while if compound wound the alternate poles are so connected that half the poles receive their series excitation from each of the main leads. In this way the corresponding characteristics are retained even if one side of the system is completely unloaded.

The discussion hinged on the feasibility of operating three-wire generators in multiple with one another or with two-wire generators. It is perfectly practicable to do this, though all three-wire generators give fluctuating e. m. f. at low loads, say, 10 per cent of full rating. It is often convenient to operate a 120-volt machine in multiple across one side of a 240-volt, three-wire system to maintain a better balance, in case that side is unloaded. The two-wire generator with rotating balancers as a competitor of the three-wire generator, has many good points, but the cheapness, simplicity and compactness of the three-wire generator are important advantages.

The morning session Sept. 12 opened with a paper by Mr. C. E. Delafield, of the Ohio Brass Company, on "High-Tension Insulators." Mr. Delafield pointed out that to-day we are face to face with the problem of transmitting power at 100,000 volts or over. In California power is transmitted more than 200 miles at 60,000 volts, but great line losses are suffered and the investment in copper is heavy. An increase in voltage from 60,000 to 150,000 would make it possible to deliver this power with much lower losses and in much greater quantity. Niagara power could be economically delivered to Boston, New York or Philadelphia if it were not for the insulator problem. The design of an insulator for high voltages should involve a consideration of all the effects of electrical tension on the dielectrics in the vicinity of the conductors. Mr. Delafield then outlined the fundamental principles of insulator designs as discussed and investigated by Gerry, Steinmetz, Perrine and Ryan.

In all the various branches of transmission, with the exception of the line insulators, it is now possible to handle potentials in excess of 75,000 volts, there being no difficulty in designing transformers and switchboard apparatus for these high potentials. In the future designing of transmission lines the possibility of increasing the voltage to a value much higher than is now in use must be considered, and energy may be economically distributed over long distances. Energy successfully generated can be distributed over long distances economically only by the use of high voltages.

Wood can be safely accepted for insulator pins up to 25,000 or 30,000 volts. Beyond that, for mechanical reasons, it is advisable to use malleable iron; but the so-called pin type of insulator has reached such dimensions in the endeavor to obtain higher voltages that it is the general opinion that this type of insulator has exceeded the limit of good line construction. Not only is it a difficult matter, from a mechanical standpoint, to find a pin that will take the necessary stress, but the problem of manufacture from the standpoint of the pottery is exceedingly difficult. It is probable that in future work a suspended type of insulator will be used, it being a comparatively simple matter mechanically, and it seems possible to design an insulator that will be both mechanically strong and possess good insulating qualities.

The suspended type of insulator would have the advantage that ample arcing distances could be provided without making the insulator topheavy and difficult to manufacture. It should not permit arcing to occur until the potential is sufficient to rupture the air and cause the current to arc from end to end, this feature being of great importance in steel tower work. On high-voltage lines where steel towers are used the pin type of insulator for 100,000 volts or higher would seem to be almost an impossibility, owing to the size necessary to take care of the wires, and to line disturbances, and owing to the fact that the earth potential is carried into the insulator by the steel pin and through the metal towers.

An ideal insulator would take care of all climatic conditions and have few still air spaces. It should expose a large part of its surface to the wind and have a long leakage distance of small area. Cemented parts, if any, should be under compression and not tension on account of expansion and contraction strains. There should be nothing but porcelain between the points of opposite potential. It is only a question of time before insulators designed along these lines will be evolved. On the insulator alone should be the reliance of the engineer for his insulation, and all insulators, whether porcelain or glass, should be tested with approximately three times the full line voltage brought to the inside of the insulator head. The cost of the insulator is not a matter of paramount importance.

In the discussion there was general agreement that lightning troubles and sometimes resonance are the more serious prob-

lems in insulator work. The Toronto-Niagara line has been remarkably successful except for lightning, which has shut down the line a few times by arcing over from the insulator to ground. The line originally had multi-gap arresters only, at the ends of the line, but the horn-gap type have since been installed, the horns being grounded 3 ft. above the transmission line on each tower. The new type of electrolytic arrester will also be installed. In one case an insulator broke and the wire struck the tower; a surge resulted, but the arc was broken by the horn gap.

The next paper was by Mr. A. E. Fleming, of the Canadian Nernst Lamp Department, on "The Value of the Nernst Lamp to the Central Station." Within the last three or four years more new types of lamps have been brought out than at any time in the 30 years' existence of the incandescent lamp. With the introduction of these new types has come a remarkable change in the sales policy of central stations. The most progressive have not only taken advantage of high efficiency lamps, but have also been more liberal and broad-minded in their dealings with consumers. Mr. Fleming emphasized the value of the Nernst lamp in meeting gas and gasoline competition and quoted at length from Mr. T. C. Martin's progress committee report to the National Electric Light Association in 1906 illustrating the success of this lamp in displacing the ordinary four-burner gas-arc lamp. He then described the different styles of Nernst lamp now on the market and discussed its color value. The latter feature was one of the strongest points in leading the Pennsylvania Railroad Terminal in New York to adopt the Nernst lamp. The illuminating engineers in charge of this work had one of the most difficult propositions to consider that has ever come before the lighting world. From the lighting of the main waiting room, which is about 300 ft. long, 100 ft. wide and 167 ft. high, to an office 16 ft. x 20 ft. x 12 ft. was the range, and 15,000 Nernst glowers were selected for the work. Marshall Field & Company, of Chicago, have replaced 40,000 incandescents by 12,000 glower units in their 38 acres of floor space.

The objection of high initial cost of the Nernst system is often raised, but the objectors do not stop to consider the low power factor of the arc lamp, which means additional outlay in secondary distribution, transformers and station equipment. Under such cases the Nernst lamp costs very nearly 50 per cent less per unit. Experienced, but not expert labor is required for maintenance, which, at the prevailing prices and guarantees on Nernst lamp repair parts in Canada, should not exceed 0.6 cents per kw-hour, and some stations claim 0.3 cents. Over 20,000 glowers have been installed in Canada, and in the United States over a million glower units are in operation. The Nernst lamp should aid the change from flat to meter rates, assist in meeting gas competition, create new advertising business, and broaden the peak by obtaining a large number of small customers whose connected load very nearly equals their daily peak consumption.

In discussion it was stated that poor regulation will shorten the life of the glower faster than variable frequency. One company reporting 618 glowers noticed a depreciation in candle-power of 30 per cent after 400 hours' burning. The cost of maintenance was 3 or 4 cents per glower, of which 10 per cent was for the maintenance of heaters. The life of glowers seems to be somewhat uncertain. To avoid the bad effects of vibration, the lamps can be hung from springs. Another company fixed the depreciation as 20 per cent in candle-power in 600 hours. Six or eight weeks ago a direct-current Nernst lamp was placed on the market, with heavier terminal and an average life of 500 hours per glower.

Mr. J. M. Robertson, of the Montreal Light, Heat & Power Company, then read a paper upon the "Present Status of Carbon and Metallic Filament Incandescent Lamps." He touched upon the history of recent high-efficiency developments and described the essential features of the types now on the market. Summing these up, the carbon filament's lowest consumption is 3.1 watts per candle-power, with short life on variable voltage; the metallized filament has a positive temperature coefficient and increase in candle-power of 80 per cent of that on increasing voltage of the carbon lamp, and a life of 560 hours on good regulation; the tantalum lamp has about double the efficiency of the carbon filament, and lamps in the 10 to 16 candle-power size, with a life of from 500 to 1000 hours, may be soon obtainable, and the life on alternating current is about 60 per cent of that on direct-current circuits; the tungsten lamp has a life of 1000 hours on a well-regulated circuit and a consumption of 1.3 w. p. c. Very careful handling of the tantalum lamp is required where short, sharp vibrations are present. Mr. Robertson then discussed a curve sheet which he had prepared, showing the relative ratings, consumptions, and candle-powers in terms of life and voltage, with tabulated costs as printed below:

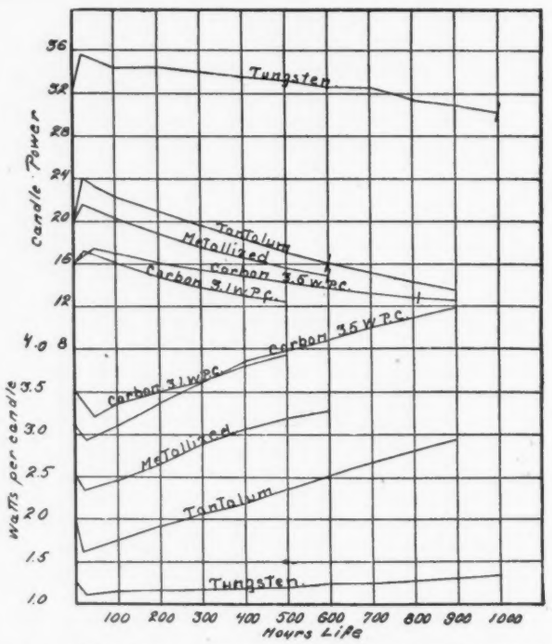


FIG. 1.—CANDLE-POWER RATING AND SPECIFIC CONSUMPTION OF VARIOUS LAMPS OPERATED AT DIFFERENT VOLTAGES.

The discussion hinged mainly upon the influence of high-efficiency lamps, particularly the new helion lamp, which is not yet on the market, upon central-station revenue. The general

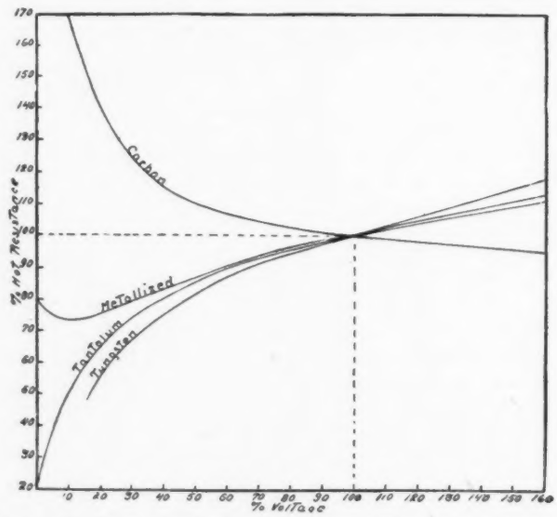


FIG. 2.—EFFECT OF CHANGE OF OPERATING VOLTAGE ON RESISTANCE OF FILAMENT.

opinion was that the industry would not be harmed for any length of time because of the time required to change-over established methods of manufacturing and the stimulus to en-

ergy sale and extensions of loads which improved lamps would bring about.

The afternoon session was opened by Mr. John Murphy's paper on "A Remedy for Frazil and Anchor Ice." Mr. Murphy exhaustively discussed the physical phenomena associated

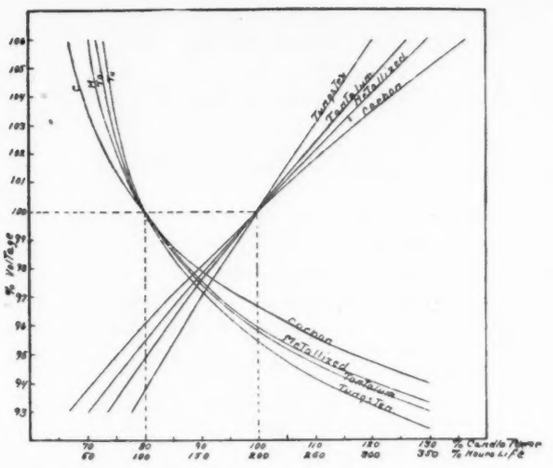


FIG. 3.—VARIATION OF LIFE AND ILLUMINATION WITH CHANGE IN THE OPERATING E. M. F.

with freezing, and showed the absolute impossibility of attempting to prevent the forming of ice in the river approaches to hydroelectric plants by the application of heat on a large scale. The surface formed ice or frazil is the chief offender, sticking to the packs, gates and wheel parts. The ice difficulties at

TABLE SHOWING THE COST OF ELECTRICITY AND RENEWALS FOR VARIOUS TYPES OF LAMPS.

Kind of Lamp	Candle Power	Amperes	W. P. C.	Total Watts	Hours Life	K. W. Hours consumed during life	Cost of Lamp	Cost of Renewals per 1000 hours	COST OF POWER PER K. W. HR.										Per cent. of difference in cost of Lamp, Labor and Power	Cost of Renewals per 1000 Watt hours.
									1c	2c	3c	4c	5c	6c	7c	8c	9c	10c		
									Combined Cost of Power and Lamp Renewals per 1000 Hours.											
Carbon Street Series	30	2.5	3.5	105	410	43	$0.75	$1.83	$2.58	$3.93	$4.98	$6.33	$7.68	$8.13	$9.18	$10.23	$11.28	$12.33	5.024	c1.744
Carbon Street Series	40	2.5	3.5	140	410	57	.88	1.95	3.33	4.75	7.15	8.55	9.95	11.35	12.75	13.15	14.55	15.95	.084	1.403
Tungsten Street Series	40	2.5	1.35	54	1000	54	2.00	2.00	2.54	3.08	3.62	4.16	4.70	5.24	5.78	6.32	6.86	7.40	.010	3.704
Carbon Street Series	60	2.5	3.5	210	410	86	.80	1.95	4.05	6.15	8.25	10.35	12.45	14.55	16.65	18.75	20.85	22.95	.024	.930
Tungsten Street Series	60	2.5	1.35	81	1000	81	2.00	2.00	2.81	3.62	4.43	5.24	6.05	6.86	7.67	8.48	9.29	10.10	.010	2.469
Metallized Multiple	40		2.5	100	575	58	.45	.78	1.78	2.78	3.78	4.78	5.78	6.78	7.78	8.78	9.78	10.78	.017	.776
Tantalum Multiple	40		2.0	80	900	72	.95	1.05	1.85	2.65	3.45	4.25	5.05	5.85	6.65	7.45	8.25	9.05	.011	1.319

Ottawa in the past winter were reviewed as illustrative. Shortage of water is another difficulty in hydroelectric plants in the cold winters of northern latitudes. Many hydraulic engineers in estimating the area drained lose sight of the fact that little or no drainage occurs during a great part of each winter in northern latitudes.

The first trouble which frazil usually causes at a hydraulic plant is to clog up the openings in the rock or screen. This may to a great extent be obviated by the use of a motor-driven rake which is more effective than hand raking in continuous service. Then the racks are kept open by raking the frazil, which passes in and forms like adhesive plaster around the gates and mechanism, thus preventing speed regulation, and finally shutting down the wheels altogether.

When the sun is shining anchor ice rises from the bottom of the stream, bringing with it loose rocks, etc., and is carried by the current into the forebay. Here the pressure of the water holds it against the rack, and while it is not adhesive or very cohesive at such times, it will stop the flow of water if it is not broken up by raking and passed through.

It was found in one case that waterwheels which had their tail races enclosed so that the cold air could not sweep in were more slowly affected by frazil than others not so protected. Waterwheels set in wooden penstocks fared better than those in exposed concrete chambers. Mr. Murphy applied a moderate amount of heat to the racks and other parts of the hydraulic equipment, and succeeded in obviating the frazil difficulties. With the aid of an old boiler which had been operating a couple of steam drills, a 3000-hp station was kept in operation throughout sieges of frazil which shut down or tied up every other waterwheel in the Ottawa district. Some experiments were carried out upon the racks at a temperature of 15 degs. F. It was only necessary to expend 180 watts upon an iron bar in a rack made up of strips 3.5 in. wide and 0.25 in. thick in order to detach solid ice which otherwise could be removed with great difficulty and with a chisel or axe. The section of the rack warmed was 5 ft. long. Waterwheels are successfully warmed by steam, also. In one station five sets of wheels are supplied by a boiler which is unable to consume more than a ton and a quarter of coal in 24 hours, and steam is not applied to the wheels continuously—though such is the proper plan when frazil is running—but it is only injected when the gates are inclined to get stiff or when the wheels show signs of dropping their loads.

An illustrated lecture on illumination was then given by Mr. V. R. Lansingh, of New York. A large number of slides of typical installations were shown, with comments upon the principles and methods involved. Illumination, both as a science and as an art, was broadly discussed.

The session of Friday included the papers of Mr. G. P. Cole, Allis-Chalmers-Bullock Company, on "Modern Lighting Transformers," and Mr. Geo. H. Montgomery, of the Montreal Light, Heat & Power Company, on "The Responsibility of Electrical Companies for Accidents." Mr. Cole's paper reviewed in detail the latest progress in core-type transformer designs and construction, with special reference to special alloyed sheet steel of low watts loss. Insulation, regulation, efficiency, small core loss, low rise of temperature and lessened cost of manufacture all depend upon sheet steel of favorable qualities, which can be had in the market; with a low watts loss iron there can be used a higher density for the same core loss, resulting in fewer turns of coils and a greater allowable coil cross-section. Efficiency and regulation are both better for this reason. Close regulation is important since the power recorded is almost in direct proportion to the voltage at the meter. Poor regulation decreases the revenue and also gives the customer poor service.

In lighting transformers of the present day no trouble need be feared from ageing, as the core plates are not clamped too tightly and the operating temperatures are comparatively low. Ageing is only due to an excessive operating temperature, and has been shown in even the worst samples of sheet iron to occur hardly ever below 80 degs. C. Such operating temperature is rarely met in lighting transformers. The rules of the German Electro-technical Society define ageing as the percentage variation of the figure of loss (which is the watts loss per kilogram at a density of 10,000 lines per sq. cm. and 50 cycles per second) caused by keeping the sample at 100 degs. C. for over 600 hours. The paper concluded with a description of modern impregnating methods.

Mr. Montgomery pointed out that electricity is in a class almost by itself as regards the difficulty of the task imposed upon those engaged in its production and distribution. The failure of appliances, the carelessness of employees, and more frequently, the reckless imprudence and gross negligence of the public afford very easy channels for the arrival of accidents. The paper reviewed a considerable number of cases against Canadian companies, and emphasized the legal bearings of reasonable care in the prevention of accidents on the part of the public and the central station.

A feature of the convention was the publication of its annual question box under the editorship of Mr. A. A. Dion, of Ottawa. This was printed in pamphlet form, and it contains a large number of practical operating points of general interest, which cannot be outlined in these paragraphs for lack of space at this time.

New Telephone Patents.

With two-wire multiple common-battery systems the necessity of devising a non-interfering busy test was at once apparent. The obvious way was the use of a high retardation relay operating upon a minute current and controlling the larger busy test current through its contacts. If such a relay be permanently connected to the cord circuits, it is evident that a leak in any one will defeat the test of a whole position. Because of this keys are arranged to connect the busy test relay to any cord during only the actual period of testing. W. W. Dean has associated his busy test and listening keys so that they are operated by different positions of a common lever. Besides this he provides an electrically operated locking device which prevents operation of the test key on any cord, if the plug be in a jack. Mr. Dean has patented this arrangement and assigned it to the Kellogg Company.

In Fig. 1, is shown a repeater circuit invented by N. A. Warth, of Columbus, Ohio. It will be noted that there is a short circuit across the line conductors at *H*. Now this divides the receiving and forwarding lines so that there can be practically no direct effect of either upon the other. It will be noted that the repeating induction coil has four sections,

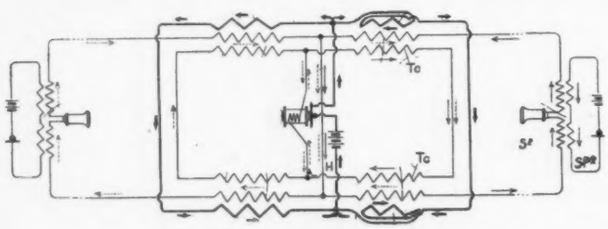


FIG. 1.—WARTH TELEPHONE REPEATER.

each of three windings. All three have corresponding bridges. In the bridge of one local circuit is the receiving part of the repeater and in the other the transmitter and battery. Now an impulse arriving from S^2 cannot pass beyond *H*. It induces currents in both locals at T_c, T_c. Those of the primaries practically all pass through the transmitter bridge without effect. Those of the tertiary affect the receiver and transmitter. The new impulses from the transmitter divide between the two primary coil circuits, with two effects; the one is a repeating of the reinforced current into the main line, while the other is a set of four potentials set up in the tertiary circuit. If these latter be of equal values and properly poled, the receiver part will be virtutally connected between equipotential points as far as this reinduced effect is concerned, and thus we have traced our repeated current through without having produced any secondary excitation of the receiving part.

Fig. 2 shows two forms of bridle rings for conveniently sup-

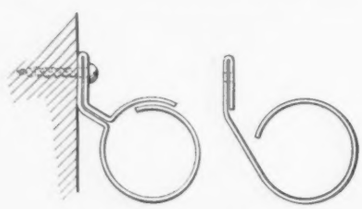


FIG. 2.—HISS BRIDLE RINGS.

porting wires along walls and fences. The cut is self-explanatory. The patentee is W. J. Hiss, Jr., of New York City.

With farmer stations there is often a considerable waste of battery due to the listening in on the line of those stations not wanted. Again there is apt to be introduced upon the line various disturbing noises picked up by the transmitters of these stations. To avoid this, A. S. Perry, of Yukon, Okla., has patented a wall set with a push switch to control the primary circuit. This switch locks in, if pushed while the receiver is off the hook, and it is released by the return of the receiver. The primary circuit is only made when the push is depressed.

R. P. Ludlow, of Philadelphia, is the inventor of a combined transmitter and receiver. A diaphragm is mounted in the usual way before the poles of a receiver magnet, and a linkage connects the diaphragm with the front electrode of a transmitter contained in the same case. The two elements are connected in series. It is expected that the received impulse will affect the diaphragm and transmitter simultaneously and that the effect of the latter upon the current will augment the original effect.

Letters to the Editors.

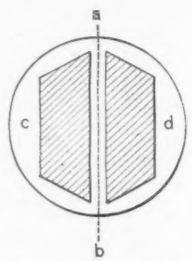
Color Photometry.

To the Editors of Electrical World:

Sirs:—All who have an interest in the subject of photometry and are acquainted with the new theories of vision as set forth in a paper by the writer, reprinted in the Smithsonian Report for 1904, will not be surprised at the results obtained by Lauriol, upon which you commented editorially in your issue of April 27.

In the first place, it is necessary to distinguish strictly between photometers for the comparison of sources of light of the same and of different color.

Both Dr. Brodhun and myself have always emphasized that our photometer (working for equality as well as contrast), was devised with a view to utilizing as fully as possible the sensitiveness of the eye to illumination differences in the comparison of sources of light of identical color. Both Dr. Brodhun (who is color-blind, and who discovered the traveling of the neutral point with decreasing brightness of the colored fields under comparison) and the writer knew very well that the ratio of the intensities of two fields of different colors depends on the size of the fields, on the absolute value of the illumination, and on the "color" of the source of light for comparison. For this reason our photometer is intended only for comparison of light of the same color. Beyond that—ultra posse nemo



PHOTOMETER DISK.

tenetur—no one is justified in using our photometer beyond its limits of application, nor in condemning it if he does so.

In the incandescent lamp industry, and in the illuminating practice where the object is always to make relative measurements, absolutely identical color can be obtained. To connect with the unit of light, however, fundamental measurements are necessary on sources of light which are not of absolutely uniform spectral quality. In reducing the paraffine candle to the hefner unit a slight inaccuracy is not of much importance. In determining the relation between incandescent lamps as standard lamps and the hefner lamp it is easy to obtain an accuracy of 1 per cent. In the case of a comparative test with a color-blind observer and the writer, the same adjustment sufficed, especially in the case of the contrast photometer, where the adjustment is made such that the two somewhat differently colored trapezoids *c* and *d* in the accompanying sketch appear with the same sharpness. This method is essentially based on the criterion of "sharpness" of vision, which alone is a correct principle for comparing differently colored sources of light, and should be further developed.

We also gave attention to the disappearance of the line *a b* in the sketch, which vanishes when the trapezoids *c* and *d* become equally sharp. The reason is that the sharp image of

a b on the retina always so strikes a retinal element that the sensation of mixed color is produced.

For comparing very differently colored fields the Lummer-Brodhun photometer fails, and must fail. Possibly the comparison of very differently colored fields has no real value. Experiments are now being made under my direction on spectral light with the flicker photometer of Rood, and determinations are being made of the "brightness-sensibility curve," which indicates how much the sensibility of the eye differs for different wave lengths. In the photometry of colored fields we are still at sea. Certainly all methods should be avoided in which, as in the comparison of brightness, the Purkinje and similar phenomena play a rôle. Unfortunately these limitations are little known.

The delay in sending this communication is due to my recent trip in the United States, and to much urgent work which had

BRESLAU, GERMANY. OTTO LUMMER.
Königl. Universität.

Iron Bridges and Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—It is popularly supposed that large, elevated masses of metal, either in the form of iron buildings or bridges, are inimical to wireless communication in their immediate neighborhood, owing to absorption or shadow effects. That this is not necessarily true was recently brought to the attention of the writer by Mr. Benjamin Dolbear.

Mr. Dolbear, then in charge of the wireless installation on the *Horatio Hall,* of the Maine Steamship Company, plying between New York and Portland, Maine, observed a very marked increase in the intensity of received signals while passing under the East River Williamsburg bridge, and a similar, although not so strongly marked effect, under the partially completed bridge at Blackwell's Island. This increase in intensity appeared to be confined to relatively short wave lengths, of the order of 500 meters or less, and was either absent or reversed in the case of long waves, as was shown by the 1800-meter waves from the Marconi station at South Wellfleet, Mass., which decreased in intensity beneath the bridges.

The writer, wishing personally to observe this effect, recently made a trip to New York on the *Horatio Hall,* and was fortunate enough to have the involuntary cooperation of a number of more or less distant stations while passing under the bridges. When within a few hundred yards north of the Williamsburg Bridge, the steamer *Priscilla,* of the Fall River Line, then about two hours out of New York, and probably some 25 miles up the Sound, commenced to send, and continued until the *Horatio Hall* passed under the bridge, and arrived at her dock on the other side. When within about a hundred yards of the bridge, the intensity of the sound in the telephone receivers began slowly to increase, reaching a maximum of about three times normal when the antenna was directly under the bridge, and then, almost immediately after leaving the bridge, falling back very sharply to normal intensity.

On the return trip, similar observations were made with the stations at Galilee, N. J., and 42 Broadway, New York, these being on the south side of the bridge. In each case the effect was the same; a slow increase in the strength of the signals as the bridge was approached from the sending station side, and a very rapid falling back to normal when the bridge was passed.

The writer would be inclined to lay this effect to a "wave chute" action of the bridge, gliding electrical waves being concentrated along the conducting structure, were it not for the fact that the stations heard were nearly at right angles to the bridge, so that the wave front must have been nearly parallel to the bridge. He trusts that this communication will lead others to make further observations in the East River, as wirelessly equipped vessels pass under the bridges daily, and sending stations are numerous.

AMESBURY, MASS. GREENLEAF W. PICKARD.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors, and Transformers.

Winding Alternator Coils.—An illustrated description of the new method of the Oerlikon Company, which has been noticed in the Digest, for constructing the coils used on armatures with open slots. The coils are formed complete and fully insulated before mounting in the slots, in which they are held, as usual, by wedges. Instead of winding them with ordinary round or rectangular cotton-covered wires, bare, flat copper strip is used. This strip is bent on formers into its final shape and arranged so as to lie flat in the slot; that is, the width of the strip takes up the whole width of the slot and the depth of the slot is occupied by a number of layers of the strips. The separate strips are next covered throughout with tape or paper, or in special cases, with micanite, and finally the completed coil is covered, at the parts which lie in the slots, with a jointless coating of micanite. It is claimed that in this way the slot space is utilized to the best advantage by reducing the necessary insulation since the turns only touch at the flat sides and the voltage difference of only a single turn occurs from layer to layer. Since the insulation is put on after the bending is completed there is no risk of breakdown during formation, and the absence of air spaces between the turns reduces the likelihood of any chemical action occurring at high pressure.—Lond. *Elec. Rev.,* Aug. 30.

Direct-Current Dynamo.—F. LOPPE.—A correction of his former mathematical study of a direct-current dynamo.—*L'Industrie Electrique,* Aug. 15.

Testing Transformers.—C. F. GUILBERT.—An article illustrated by diagrams on a method of testing transformers which is a modification of the old method of Sumpner.—*L'Eclairage Electrique,* Aug. 24.

Lamps and Lighting.

Direct-Current Metallic Arcs.—C. E. GUYE AND L. ZEBRIKOFF.—An abstract of a French Academy paper. Mrs. Ayrton has shown that the power P consumed in a carbon arc with different currents i may be represented by a straight line according to the equation

$$P = A + Bi$$

where A and B are constants, and the length of the arc is assumed to be constant. On the other hand, if the current is held constant and the length l of the arc is varied, the relation is again a straight line according to the equation

$$P = C + Dl$$

From these two equations she has found a formula which represents very well the potential difference e at the electrodes as a function of arc length and current. This formula is

$$e = a + bl + \frac{c + dl}{i}$$

where a, b, c, and d are constants which depend on the nature of the electrodes and the conditions of the atmosphere in which the arc burns. The present authors have made experiments with arcs between metals and have found that the above formula applies very well to them. Care was taken to have stable arcs. The results are given in the following table, the figures for a, b, c and d, being the coefficients in the above formula. The figures on carbon are those of Mrs. Ayrton; those for the other metals are the results of the present authors.

	a	*b*	*c*	*d*
Carbon	38.88	2.074	11.66	10.54
Gold	20.82	4.62	12.17	20.97
Platinum	24.29	4.80	0.00	20.33
Silver	14.19	3.64	11.36	19.01
Palladium	21.64	3.70	21.78	21.78
Copper	21.38	3.03	10.69	15.24
Cobalt	20.71	2.05	2.07	10.12
Nickel	17.14	3.89	0.00	17.48
Iron	15.73	2.52	9.44	15.02

The above formula, with the above numerical coefficients, is said to represent very well the potential difference at the electrodes for short and stable arcs.—*L'Industrie Elec.*, Aug. 25.

High-Pressure Gas Lamp with Thermo-Element.—Abraham.—At the recent annual meeting of the German Society of Gas and Water Engineers, the author gave a demonstration of the new Lucas compressed-gas lamp with a thermo-element. The disadvantage of ordinary compressed-gas lamps (which, on account of their intense light, are believed to be in the best position to compete with electric arc lamps) is the necessity of providing compressors which need attendance, the use of special pipes and special fittings, etc. Lucas avoids all this by providing a small thermo-element to each lamp. It consists of two different alloys, one an alloy of copper and aluminum and the other an alloy of copper and nickel. Each of the alloys is quite refractory and since the waste gases contain sufficient heat there is no necessity of using a highly efficient thermo-element. This thermo-element supplies current to a small motor, which drives a ventilator for compressing the gas. The operation is as follows: The lamp is first lighted and the flame, with comparatively small candle-power, heats the thermo-element, which now generates a voltage. After about half a minute the ventilator begins to move and sucks air in, revolving at a speed of 2000 r. p. m. The air is mixed within the box with the entering illuminating gas and the mixture of gas and air is supplied under the required higher pressure into the incandescent mantle. In the first construction of the thermo-element, its life was found to be a year, but by some modifications the life is believed to have been lengthened now a great deal beyond this period.—*Jour. f. Gasbeleucht*, Aug. 24.

Mercury-Vapor Lamps.—A note on a new form of the Bastian mercury-vapor lamp, which is illustrated in Fig. 1. The lamp takes about 500 watts at 200 or 220 volts. The lamp tube

FIG. 1.—MERCURY VAPOR LAMP.

is about 28 ins. long, so that the light emitting surface is of large area. In former types the incandescent lamps were connected in parallel with a mercury-vapor lamp, thus increasing the current required. In the new type, however, the lamp is started by pulling the cord to tilt the tube, a small external resistance being in series with it. The external resistance is then cut out and replaced by the incandescent lamps. The light is stated to be remarkably free from shadows, "and effectively lights a large area, the candle-power, so far as it is practicable to measure it, being greater than that of an arc lamp of equivalent watts, while no trimming or other attention is required during its life. The quality of the light with the incandescent lamps in circuit is very nearly white, the ghastly effects of the pure mercury-vapor lamp being absent."—Lond. *Electrical Review*, Aug. 23.

Arc Lamps.—Barchewitz.—An account of a paper in which he described the Carbone arc lamp, which has been repeatedly noticed in the Digest. The author also describes the latest lamp made by the same company, which is called the "Radiante" direct-current lamp. In principle the system of regulation of these lamps is the same as in lamps with inclined carbons, but in the new lamp the carbons are placed one above the other. The "radiants" burn 20 to 30 hours and are made for any desired current up to 12 amperes at an e. m. f. of 80 volts per lamp.—*Elek. Zeit.*, Aug. 29.

New Lamps.—A second article on recent advances in artificial lighting. The present installment deals with arc and vacuum-tube electric lamps under the following headings: Light from gases and vapors; direct and alternating-current arcs; luminous arcs; flame arcs; metallic arc lamps; use of metallic arc lamps as rectifiers; Cooper-Hewitt mercury-vapor lamps, and Moore vacuum-tube lamps.—*Eng'ing News*, Sept. 12.

Power.

Water Power.—J. Smyth.—A paper read before the British Association in which the author states that many falls of water are not utilized because they are considered too small and the flow of water too irregular. The author claims that such falls may be made valuable by using a source of variable auxiliary power to supplement the water supply. The following instance is given: On the upper Bann River, in the North of Ireland, there are a number of these small falls. On one of these the head is 8 ft. 2½ ins., but as there is a loss from a long and somewhat narrow race in part of its course, only 7 ft. 6 ins. is reckoned on. Two Achilles turbines, one 48 ins. in diameter and one 36 ins., have been erected at this fall. They are capable of developing 126 horse-power with a discharge of 11,095 cu. ft. per minute at full gate of sluice. As it is an advantage to work with something less than full gate with such turbines, they are never required to do more than about 112 horse-power. There are reservoirs provided for the river by a public company to keep up the normal supply in summer and in scarce times to 4500 cu. ft. per minute or 54 horse-power. At these and intermediate times the necessary power for the machinery is kept up by a steam engine, so that it is estimated that an average of 83 horse-power is obtained. Had a turbine, or turbines in this case, been erected for only the normal supply, a loss would have resulted of 3.8 horse-power throughout the year (or $95 per annum if steam were used for 10 hours' drive per day). A steam engine is used as the supplemental motor in this case, as the works are used for bleaching, where the steam is passed through a high-pressure engine at 65 lbs. per sq. in. and leaves it at about 4 lbs. passing into another boiler, thence to do the boiling and heating required in such works, and thereby great economy is secured. In other works the supplemental power might be obtained from an oil or gas engine.—Lond. *Elec. Review*, Aug. 23.

Cost of Water-Power Plant.—A note giving some data on the cost of the water-power plant which supplies the electrolytic chlorate factory at Vallorbe, in Switzerland. The height of fall is 70 m., the power utilized amounts to 3000 horse-power, and the output of the works is from 900 to 1000 tons of chlorates per year, calculated at the round figure of one ton per hp-day. The expenditure was as follows:

Concession and land	$6,000
Dam	4,000
Tunnel, etc	10,000
Pipe line	6,000
Turbines and sluice-gates	22,000
Buildings	4,000
Dynamos	60,000
Sundries	8,000
	$120,000

Thus the cost per horse-power was $40. Interest and depreciation at 10 per cent make $4 per hp-year. These results are exceptionally favorable; more usually, it is stated, the cost of installation would average $80 per horse-power and the annual charges $8.—Lond. *Electrical Review*, Aug. 23.

Electric Driving of Rolling Mill.—A note giving some data on the electrical drive in the Peiner rolling mills, which obtain 4000 kilowatts from the metallurgical works of Ilsede, 4½ miles away. This is partly generated in an old three-phase steam station at 500 volts, the e. m. f. being increased to 10,000 volts for transmission. In parallel with this is a second sta-

tion in which three-phase currents are generated at 10,000 volts by gas engines operated with blast-furnace gas. The transmission lines, which are in duplicate, consist of six silicon-bronze wires 0.075-in. in section. At full load the voltage drop is 6 per cent, and the total loss is 4 per cent. In the rolling mills there are three synchronous-motor-generators each of 800 kilowatt capacity, which convert the three-phase currents into continuous current at 500 volts. There are also three 500-kw stationary transformers, which reduce the e. m. f. to 500 volts. The e. m. f. is further reduced to 110 volts for lighting purposes. There is a 289-cell battery with a rating of 2000 ampere-hours. The load in the rolling mills, which averages in the mean 1540, varies between 600 kilowatts and 1800 kilowatts. The transmission line also feeds a phosphorus factory, and an induction motor-converter supplies direct current to the slack conveyor. The total horse-power of the motors installed is 5772.—Lond. *Electrician*, Aug. 23.

Turbo Alternator.—An illustrated description of a large three-phase turbo-alternator built by a German company. It has a capacity of 2500 k. v. a.—*L'Industrie Electrique*, Aug. 25.

Traction.

Alternating-Current Traction.—J. SAHULKA.—A paper read before the last meeting of the German Association of Electrical Engineers on two new systems of alternating-current traction. Single-phase or polyphase currents may be used. Since no regulating resistances are required which are operated by the main current, the efficiency is claimed to be high. With the first system direct current may also be used. The first system is shown diagrammatically in Fig. 2. The motor *M* is

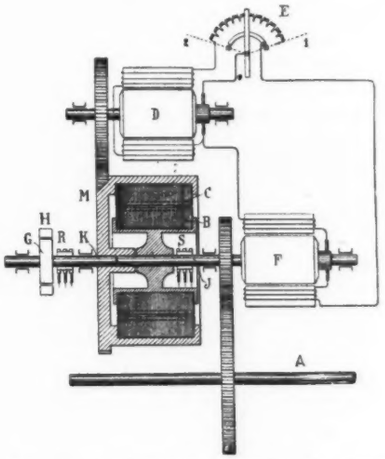


FIG. 2.—ALTERNATING-CURRENT TRACTION

the main motor, and both its parts are movable. It acts on the driving axle *A* and on a direct-current shunt-wound generator *D*, which supplies energy to the motor *F*, which also acts on the axle *A*. In the illustration the motor *M* is assumed to be a three-phase induction machine which is operated directly by high-tension three-phase currents, but *M* could also be any other type of motor, either direct-current or alternating-current. The inner part *B* of the motor is mounted on the axle *J*; the outer part *C* is mounted on the concentric axle *K*. The operating currents are supplied to *C* by means of the slip-rings *R*. On the axle *J* slip-rings *S* may also be provided in order to use resistors during the starting of the motor *M*. These resistors may have a very small resistance, since the motor *M* is started unloaded. The member *B* acts on the axle *A*. In the same way the member *C* drives the shunt dynamo *D*, which supplies current to the motor *F*, which is mounted on the same axle *J* as the member *B* of the main motor *M*. The regulation of speed of the axle *A* is accomplished by the shunt rheostat *E* of the dynamo *D*. In starting, the motor *M* is first started unloaded, the circuit between *D* and *F* being broken. The lever of the resistance *E* is, therefore, in the position 1. If the motor *M* is started in this way, only the outer member *C* begins to run, and it reaches a certain maximum speed. In order to start the axle *A*, the circuit between *D* and *F* is closed by moving the lever of *E* to the left. The excitation of *D* is thus gradually increased. The motor *F*, therefore, receives current of gradually increasing intensity and drives the axle *A*. This is simultaneously driven by the main motor *M*. The dynamo *D* counteracts the motion of *C* so that the rotor *B* exerts a torque on the axle *K* and, therefore, also on the axle *A*. The greater excitation of the dynamo *D*, the greater is the driving effect of the motors *M* and *F* on the axle *A*. The regulation of speed of *A* is accomplished by the regulating rheostat *E* which may have a great number of steps. When the axle *A* is driven as described above the motor *M* gives half of its power directly to the axle *A*, while the other half is supplied to the dynamo *D*, which furnishes the current for the motor *F*. The motor *M* must therefore be sufficiently large to develop the whole power necessary for driving the axle *A*, while either of the two machines *D* and *F* needs to be of only half this rating. At any speed of the axle *A* the efficiency is high since the main motor *M* always runs at high speed and there are no losses in main-current rheostat. If *M* is an induction motor, the slip is very small at any speed of the axle *A*. The speed of the axle *A* may be increased beyond the value obtainable by diminishing the resistance *E*, by interrupting the circuit between *D* and *F* and turning on the brake *G* and *H* so as to bring the member *C* of the motor *M* to rest. The speed of the member *B* and of the axle *A* is thereby raised to a maximum and the axle *A* is driven only by the main motor *M*. The dynamo *D* is at rest and the motor *F* runs together with the motor *M*, but without current. This system enables the recuperation of energy when running down grades. In this case the main motor *M* must be an induction motor or a direct-current shunt motor. As soon as the member *C* of the motor *M* is brought to rest by breaking and the speed of the axle *A* rises beyond a certain value, the motor *M* returns energy to the network. Even at a lower speed of the axle (as long as the member *C* is not yet brought to rest) energy may be given back from the motor to the network by separately exciting the field magnet of the motor *F*. In this case, up to a certain speed of the axle *A*, the machine *F* acts as a generator supplying energy to the machine *D*, which now acts as a motor and raises the speed of the main motor *M* above synchronism so that again energy is returned

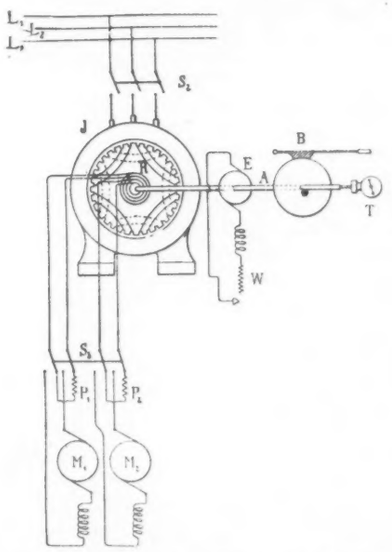


FIG. 3.—ALTERNATING-CURRENT TRACTION.

to the network. If direct current is used, the recuperation of energy requires that all three machines *M*, *D* and *F* be shunt wound. The system is claimed to have certain advantages over the Ward-Leonard system. The second system described in the paper employs single-phase commutator motors or three-phase induction motors. During starting they are supplied

with alternating current of gradually increasing frequency and e. m. f. from an induction motor acting as frequency changer. The arrangement is shown in Fig. 3. Three-phase currents are supplied to the induction motor J. Its rotor has a two-phase winding, the induced currents being taken off by means of the slip-rings R. The motor J is started unloaded; for this purpose the rotor windings are closed through the resistances P_1 and P_2. The two motors M_1 and M_2, which act on the driving axles are shown in the illustration as single-phase commutator motors with series windings. In order to start the motors the windings of the rotor of J are first connected by means of the switch S_3 with the motors M_1 and M_2 without the use of starting resistances. The motors M_1 and M_2 do not yet start, since J runs almost synchronously so that only a very small e. m. f. is induced in the windings of its rotor. By braking the rotor of J by means of the mechanical brake B, the frequency and voltage of the currents supplied to the motors M_1 and M_2 increase and the speed of these motors therefore begins to increase. By means of the brake B the speed of J may be varied so that the voltage and the frequency of the current supplied to M_1 and M_2 is simultaneously changed. At the end of the starting period, the motor J can be completely brought to rest by means of the brake B and acts then simply as stationary transformer. Since in the beginning of the starting period the frequency of the current supplied to M_1 and M_2 is very small, the disadvantages in starting single-phase commutator motors are avoided. The illustration also shows a braking dynamo E, which also acts on the axle of the induction motor J. Both B and E should be used for starting, while when running at medium speed E alone should be used. When M_1 and M_2 are to be brought to maximum speed the motor J is brought to rest by means of B.—*Elek. Zeit.*, Aug. 29.

Liverpool.—An abstract of the last report of the Municipal Tramways of Liverpool. The number of kw-hours used per car-mile increased from 1.448 in 1903 to 1.566 in 1904, 1.677 in 1905 and to 1.730 in 1906. The percentage increase in 1906 over the preceding year was three. On the other hand, the number of passengers carried increased 2.5 per cent, and the mileage 0.4 per cent. The cost per car-mile was 5.890 cents for traffic expenses, 3.262 cents for general repairs and maintenance, 3.960 cents for energy, 2.158 for general expenses, hence total expenses, excluding capital charges, 15.270 cents, and if the capital charges are included this figure becomes 22.022 cents. On the other hand, the income from all sources per car-mile was 23.114 cents.—Lond. *Electrician*, Aug. 23.

Installations, Systems and Appliances.

Manchester.—In the early nineties when the battle between continuous and alternating-current systems was at its height, Manchester was looked upon as the most powerful stronghold of the former and was recorded as an efficient example of what could be done with multi-wire distribution. In spite of this experience, this municipality has established within the past six years one of the largest alternating-current stations in England and is now supplying polyphase power direct to consumers' premises. At the present time the large Stuart Street station contains 27,000 horse-power of equipment comprising slow-speed vertical engines and flywheel alternators, but a 6000-kw steam turbine is being added and will shortly be put in service. Approximately 10,000 horse-power of this equipment is at the disposal of the motor supply, the remaining and greater portion taking the traction and lamp loads. The high-tension feeders are run in a cable tunnel, the feeders being three-core, paper-insulated and armored with steel wires. Beyond the tunnel the cables are laid in the ground in iron troughs filled with bitumen compound. The consumers' sub-station equipment is, in the case of new installations, arranged for polyphase supply entirely. When private plants have already continuous current in use and the motors are too numerous to be replaced by alternating-current machines, provision is made in the sub-station for a suitable converting equipment. In the present installment the sub-station equipment is described in detail with many diagrams and illustrations. The article is to be concluded.—Lond. *Electrician*, Aug. 23.

Synchronizing.—P. MacGahan and H. W. Young.—An illustrated article in which the authors first discuss visual or indicating devices for synchronizing alternators, namely, the use of synchronizing lamps and the use of synchroscopes either of the inductor or of the Lincoln type. In the second part of the article an automatic synchronizer is described which is primarily intended for use in stations operating large machines and where it is essential that synchronizing be done rapidly and safely. In an editorial note by P. N. Lincoln the difference between machine operation and hand operation in this case is said to be that the machine uses no judgment and makes no mistakes, while a man may use judgment, but is prone to make mistakes. The experience already gained in practice has shown that personal judgment can be dispensed with in synchronizing, and that manual mistakes are more frequent than machine derangement.—*Electric Journal*, September.

Notation for Polyphase Circuits.—C. H. Porter.—In working out the current and voltage relations in complex cases of polyphase circuits the particular notation employed must be clearly defined. The author uses clock-face diagrams, and his notation is based essentially on lettering every junction and terminal on the diagram of connections and on the use of two subscripts with every symbol of current, or e. m. f., or a vector representing them. The vector diagram must be carefully distinguished from the diagram of connections, although there is a certain similarity between them in the simpler cases. The method of applying this notation is explained and illustrated by several problems.—*Electric Journal*, September.

Regulation of the Use of Electric Energy.—The regulations proposed to be made by the (British) Home Secretary for the generation, transformation, distribution and use of electrical energy in premises under the factory and workshop act of 1901. —Lond. *Electrician*, Aug. 23.

Wires, Wiring and Conduits.

Soldering.—A. Lippman.—Concerning joints made by soldering, the regulation of the German Association of Electrical Engineers is that the solder shall not contain anything which attacks the metal. Weber adds for explanation that colophony (common rosin) is suitable, but that in no instance should any acid be used. The present author discusses the different solders and their specific effects, and points out that any objection which might be raised against the content of acid in a solder cannot be based on the effect of the acid in the soldering process itself (since here it is advantageous), but only on after-effects, the metal being attacked by the acid after the joint has been made. But such after-effects are possible only when the workman is careless. The author shows that it is impracticable not to use any acid if one desires to omit previous careful cleaning of the metallic surfaces either by mechanical or chemical means. Further, the author's researches have shown that so-called absolutely acid-free solders may contain no acid when they are bought, but are liable to cause the formation of an acid later on; finally, common rosin contains some free organic acid. The article is to be continued.—*Elek. Zeit.*, Aug. 29.

Records and Drawings of Electric Mains.—W. M. Milnes.—An account of the methods adopted by the electricity works of Burnley for keeping records and drawings of their mains. As long as the supply amounted to only a small output over a small area the mains were simply plotted on ordnance survey maps of the supply area, but when the supply increased this method was no longer satisfactory and a new system was devised. The new system is described and illustrated.—Lond. *Electrical Review*, Aug. 16.

Electrophysics and Magnetism.

Resonance.—G. Benischke.—If in an alternating-current circuit a condenser and an inductance coil are connected in series, resonance occurs when the inductive and the condensive reactances are equal. The resonance phenomenon is, however, changed with respect to the point of its occurrence and the am-

plitude of the condenser is not a perfect one, but has a certain conductance, or if the self-inductance of the inductance coil is complicated by eddy currents or magnetic hysteresis. The author formerly investigated the effect of the conductivity of a condenser and in the present article he outlines the effects of eddy currents and hysteresis. He finds that the point at which resonance occurs is changed, and takes place at a lower condensive reactance. The maximum of the current is also smaller. Both of these effects are the stronger the stronger the eddy currents and hysteresis and the higher the frequency.—*Elek. u. Masch.,* Aug. 18.

Direction of Induced Currents.—H. L. KIRKER.—In an article illustrated by diagrams, the author describes an easy method for remembering the relation between the direction of induced current and motion of a conductor in a magnetic field. One must remember that a current-carrying circuit is encircled by circular lines of force and that the relation of the direction of the magnetic lines to the direction of the current in the wire is that of right-hand rotation, and the forward-travel of a corkscrew. He then assumes the encircling magnetism to be a magnetic whirl or vortex. If such encircling magnetic lines come into the neighborhood of another wire they are held back from jumping across the wire, thus forming a bend or dent in the vortex. This dent becomes an incipient vortex around the neighboring wire and this gives an immediate indication of the current produced.—*Electric Journal,* September.

Electrochemistry and Batteries.

Storage Battery Development.—L. H. FLANDERS.—An article in which the author discusses the trend of the development of the lead storage battery. For the positive plate of the Plante type the principal object of design is now to confine the buckling effect to the individual sections and not to let it develop in the plate as a whole; also to make all parts of the active mass equally accessible to the current and to the electrolyte. The trouble in the negative plate of the Plante type is the loss of capacity due to the shrinkage of the negative material, on account of cohesion and welding together of particles of the porous mass. This has recently been overcome by the introduction of inert material into the pores of the spongy mass, which prevents the collapsing and sticking together of the walls of the pores. There is little probability of any development being made in the electrolyte beyond increasing and maintaining its purity. With respect to containers, efforts are now being made to manufacture glazed earthenware tanks. If successful, they will prove absolutely permanent and while their first cost will probably be somewhat higher than lead-lined wooden tanks, the reduced maintenance charge will more than compensate for this increase. The greatest care is necessary in the installation of batteries, since proper installation is a large factor in reducing the maintenance expense. In charging, the author recommends the determination of the end of the charge by the measurements of specific gravity rather than by voltage measurements. The persistent use of the auxiliary cadmium electrode to determine whether trouble is caused by the positive or negative plates should be encouraged. The use of distilled water for replenishing the loss in the solution due to the evaporation and care in preventing impurities from getting into the cells must be insisted upon.—*Electric Journal,* September.

Electric Hardening Furnace.—L. M. COHN.—A paper read before the Vienna Electrical Society on an electric furnace for hardening steel. The advantages are that the temperature can be quickly raised to any desired point and can be very carefully regulated and maintained. The furnace is essentially a crucible, which is carefully insulated to prevent loss of heat. Current is introduced into the crucible through two terminal plates of wrought iron. The crucible is filled with a metallic salt which is a non-conductor at ordinary temperatures, but a conductor at higher temperatures. In order to fuse the salt a piece of carbon is first inserted between the two iron terminal plates so that the current can pass through it and heat the surrounding particles of the salt. Comparisons are made concerning the cost of hardening steel in a gas furnace and in an electric furnace. The results of tests have shown that with the electric furnace it is possible to reduce the time required very considerably so that the cost of attendance and wages is also reduced. The total cost for doing the same work, in the case in question, with the electric furnace was found to be only about one-third of that with the gas furnace.—*Elek. u. Masch.,* Aug. 18 and 25.

Electric Iron Ore Reduction.—A. E. GREEN AND F. S. MACGREGOR.—An account of an experimental investigation of reduction of iron ore in an electric furnace rated at about 30 kilowatts. The construction of the furnace and the methods of measurements are described, and the results of some runs with the amount of energy consumed are given.—*Electrochem. and Met. Ind.,* September.

Units, Measurements and Instruments.

Photometry.—A conference of the International Commission for Photometry was held in Zurich from July 16 to 18. Fifteen delegates were present, France being represented by five, Germany by four, England by two, and Italy, Austria, Holland and Switzerland each by one. On the basis of reports presented by the (German) Reichsanstalt, by the (British) National Physical Laboratory, by the Central Laboratory of Electricity in Paris and by the Testing Laboratory of the Conservatoire des Arts et Metiers in Paris, the conference adopted the following relations between the fundamental units of light:

1 carcel = 10.7$_8$ hefner
1 harcourt = 10.9$_5$ hefner
1 harcourt = 1.02$_0$ carcel.

These figures are considered to be correct within 1 per cent.. The last digit, which is printed in small type, is uncertain. The carcel and the harcourt are assumed to burn in air containing 10 liters of steam per cubic meter, the hefner in air containing 8.8 liters of steam per cubic meter. In order to prevent confusion the conference recommends the following notation:

I_h horizontal candle-power (intensity)
I_{a_s} candle-power at the angle α above the horizontal
I_{a_i} candle-power at the angle α below the horizontal
I_0 mean spherical candle-power
$I \supset$ mean upper hemispherical candle-power
$I \subset$ mean lower hemispherical candle-power
$I_{m a_s}$ maximum candle-power at the angle α above the horizontal
$I_{m a_i}$ maximum candle-power at the angle α below the horizontal.

(The United States seems not to have been represented at the conference.)—*L'Industrie Elec.,* Aug. 10.

Universal Instrument for High-Frequency Currents.—E. NESPER.—The first part of a description of a universal measuring instrument for high-frequency currents and oscillations. It may be used as a calibrated resonator for measuring frequencies and wave lengths, for plotting resonance curves or for the production of oscillations of certain frequencies, etc. It is essentially a closed oscillation circuit in which a condenser of variable capacity is made use of. Indicating and exciting devices may be connected to the instrument in various ways.—*Elek. Zeit.,* Aug. 29.

High-Temperature Measurements with the Nernst Glower.—C. E. MENDENHALL and L. R. INGERSOLL.—By a graphical extrapolation of the empirical isochromatic radiation formula the authors determined the working temperature of the Nernst glower. For an 0.8-ampere, 110-volt glower, 1.04 mm. in diameter, the temperature may be perhaps placed at 2120 or 2200 degrees C. (according to the value accepted for the platinum melting point, which is either 1745 deg. C., or 1789 degrees C.); for one, 1.30 mm. in diameter, the temperature is some 200 degrees lower. The maximum temperature attainable with the Nernst glower is about 2380 degrees C., or 2490 degrees C. The authors have also used the glower as a species of optical meldometer, which, for the determination of high temperature melting points, seems to have certain decided advantages, namely, simplicity of method, great temperature-range and, at least for certain classes of metals, freedom from contamination and alloying of metals used. In this way a number of melting points have been determined. For each melting point two figures are given according to the uncertainty

in the melting point of platinum mentioned above. The melting point of silicon is 1434 degrees C. or 1452 degrees, the melting point of palladium 1548 or 1576, that or rhodium 1907 or 1968 (this is useful as a reference point), that of iridium 2292 or 2388.—*Phys. Review,* July.

Units and Standards.—The report of the (British) Association Committee on practical standards for electrical measurements. The chief points of the report have already been noticed in the Digest. Three appendices are reprinted in full, all emanating from the (British) National Physical Laboratory. The first gives notes on the present condition of the work on electrical units at that laboratory; the second gives the specification for the practical application of the definition of the international ampere, and the third exact rules as to the preparation of the Weston cadmium standard cell.—Lond. *Elec.,* Aug. 16.

Standard Cells.—G. A. Hulett.—An account of an experimental investigation of the chemistry of mercurous sulphate, cadmium sulphate and the cadmium cell, with observations on the ageing of standard cells.—*Phys. Review,* July.

Inductance.—An abstract of a Physical Society paper, by L. Cohen, on an exact formula for the mutual inductance of coaxial solenoids, and an abstract of a paper by E. P. Rosa on a new method for the absolute measurement of inductance. —*Phys. Review,* July.

Meter.—An official announcement of the Reichsanstalt admitting for calibration an alternating-current induction meter of the Siemens-Schuckert Company and describing its action and construction.—*Elek. Zeit.,* Aug. 29.

Testing Switchboard.—An illustrated description of the general arrangement of a board for testing direct-current motors and dynamos with little trouble.—Lond. *Elec. Review,* Aug. 30.

Telegraphy, Telephony and Signals.

Railway Signals.—J. B. Struble.—In a continuation of the illustrated serial on railway signals, automatic block signaling by means of alternating currents is discussed. There are two schemes of using alternating current, the signal-rail return system and the double-rail return system. In the former, one rail of each track is insulated into block sections for signaling purposes, the other rail serving as a continuous return for the power current and as one side of the alternating-current track circuit. In the latter, both are insulated into block sections and both are used for the power current. This is accomplished by the use of balanced inductive bonds and is used in preference to the single-rail system under certain conditions. In the present article the single-rail scheme and various features of its application are discussed and illustrated. The remarkable record of performance of the single-rail system in the New York subway is noted. The failures due to all causes, many of which are not directly chargeable to the signal apparatus, are about one to every 400,000 signal operations. Some months it is not so good, while in others it is better. Finally some notes are given on alternating-current signals on steam roads.—*Electric Journal,* September.

Perforator.—Many attempts have been made in recent years to devise a Wheatstone perforator actuated by a typewriter keyboard. The machines hitherto designed have involved the entire replacement of the perforators previously in use, but the most recent invention avoids the necessity for scrapping existing plant by applying a keyboard to manipulate the levers of the existing apparatus. The apparatus which is described and illustrated in this article is invented by M. Kotyra and consists of two essential parts, namely, three electromagnets and a keyboard. The combination can be used in conjunction either with an ordinary perforator or with a pneumatic puncher, the electromagnets being so applied to the plungers that, when actuated by the keyboard, they perform the work known as punching, at present done by hand or by air pressure.—Lond. *Electrical Review,* Aug. 16.

Wireless Telegraphy.—Oliver Lodge.—A paper read before the (British) Association on tuning in wireless telegraphy. The author deals with the characteristics of a "tuned arc" station as distinct from a "spark" station.—Lond. *Electrician,* Aug. 23.

Telephone Relays.—A. Soulier.—A review of the subject with a brief summary of those systems which have been proposed.—*L'Industrie Electrique,* Aug. 25.

Cable Connections.—H. Schultz.—An illustrated description of a new type of telephone-cable end-connections.—*Elek. Zeit.,* Aug. 29.

Miscellaneous.

Removal of Limitations of Electricity.—C. F. Scott.—An address delivered at the Worcester Polytechnic Institute discussing the various limitations which have been removed by the application of electricity. By removing the mechanical difficulties and limitations in the distribution of power the electric system has completely revolutionized the methods of generating power, has concentrated the generation of power and has made the large steam turbine and the large gas engine possible. The waste gases of blast furnaces are now becoming the sole source of power in some plants. Electricity has also brought into service water power. The natural result is cheap energy. With respect to the applications of electricity the facility of transforming electrical energy into other forms of energy is pointed out. The principal substitution of the steam locomotive by electricity have been radical ones, for not only the steam, but the locomotives themselves have been eliminated. The method of distributing power in workshops has been revolutionized. In ordinary life the telephone has removed the limitation of the range of the human voice.—*Electric Journal,* September.

Sales Contracts.—B. A. Brennan.—The third article of his serial. The author deals with bailments or lease contracts, consignments, contracts by post, statutes of fraud, promises and agreements not contained in contracts, sellers' remedies and buyers' remedies, warranties.—*Electric Journal,* September.

Electromedical Equipment in English Hospital.—An account of the equipment of the Royal Devon and Exeter Hospital. The apparatus in use includes a Finsen ultra-violet lamp equipment and a large induction coil with mercury break for X-ray work, which is used in conjunction with a valve tube and has one secondary terminal permanently earthed. The same induction coil can be used in conjunction with a resonator for high-frequency treatment. A special machine is used for giving sinusoidal currents, and apparatus is provided for applying continuous or interrupted currents. Special precautions are taken in the case of the bath for electrical treatment to prevent excessive currents being transmitted to the patient from leakage or other accidental causes.—Lond. *Electrical Engineering,* Aug. 15.

Magnetic Character of Ships.—W. Bartling.—A paper in which the author discusses the development of the magnetic character of a steel ship and the improvement of the compass position by the use of non-magnetic material.—Lond. *Electrician,* Aug. 16.

Lightning Rods.—A note on the work done by the Paris Academy of Science with respect to the construction of lightning rods. As early as 1784 a set of instructions on the erection of lightning rods was presented to the Academy by Franklin, LeRoy, Coulomb, De Leplace and Rochon. This is here reprinted.—*Elek. Zeit.,* Aug. 15.

Electrical Inspectors' Convention.

The third annual meeting of the Western Association of Electrical Inspectors will be held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907. Tuesday, Oct. 22, will be taken up by business sessions and by reports of committees on "Uniformity in Rulings," "National Electrical Code," "Outside Wiring," "Theater Wiring" and "Show Equipment." Wednesday, Oct. 23, a number of addresses will be given as follows: "Approved Electrical Fittings," by Mr. Dana Pierce, electrical engineer, Underwriters' Laboratories, Chicago; "Joint Construction Pole Lines," by Mr. H. B. Gear, general inspector, Chicago Edison

Company; "Electrical Inspection from the Viewpoint of the Central Station," by Mr. Paul Doty, manager, St. Paul Gas & Electric Company; "Electrical Inspection from the Viewpoint of the Telephone Exchange," by Mr. Chas. M. Mauseau, general manager, Northwestern telephone exchange, Minneapolis; "Flexible Cords for Pendants," by Mr. H. T. Wreaks, secretary, Wire Extension Bureau, New York. The evening session, Oct. 23, is to be devoted to discussion of "Difficulties Arising in Electrical Inspection Work," by members.

Thursday, Oct. 24, is to be given to reports of the following committees: "Grounding of Conductors for Safety," "Construction and Installation of Electric Signs," "Show Window and Display Lighting," "Instructions to the Public Concerning Safe Operation and Maintenance of Electrical Wiring and Apparatus," "Underground Systems," "Installation and Operation of Induction Motors," "Wiring for Electric Cranes," "Laws and Ordinances," "Architects' Specifications." Tours of inspection are to be arranged for those desiring to see up-to-date installations of wiring, to include knob and tube work, exposed wiring, conduit work, high-tension motor installation, theater wiring installation, and an underground tunnel system for electrical conductors. The secretary of the association is Mr. William S. Boyd, 382 Ohio Street, Chicago.

Incandescent Lamp Exhibit at Montreal.

In our issue for Sept. 14 an account was given of the exhibits and other attractions at the Canadian Electrical Exhibition which was held in Montreal last week. The accompanying illustrations give a general idea of the appearance of the hall and show the tasty arrangement of the exhibits and the attractive decorations of the room.

Following are a few additional notes of the exhibits, referring particularly to the display of incandescent lamps. The exhibit of the Sunbeam Incandescent Lamp Company of Canada, Limited, and the Holophane Company, conducted through the engineering department of the National Electric Lamp Association, of Cleveland, Ohio, was very prominent.

At the corners of the booth were pillars on the top of which were fixtures equipped with 100-cp, 250-watt Gem graphitized filament 40-cp lamps, tantalum, meridian and 80-cp, 100-watt tungsten lamps. Between the pillars was an iron framework from which were suspended 20-cp, 40-watt tantalum meridian lamps, 40-cp, 27-volt tungsten lamps, and Gem graphitized filament 50-watt lamps, as well as 40 and 80-watt regular tantalum lamps. Each of these lamps was equipped with some form of Holophane reflector, which protects the eye from the glare of

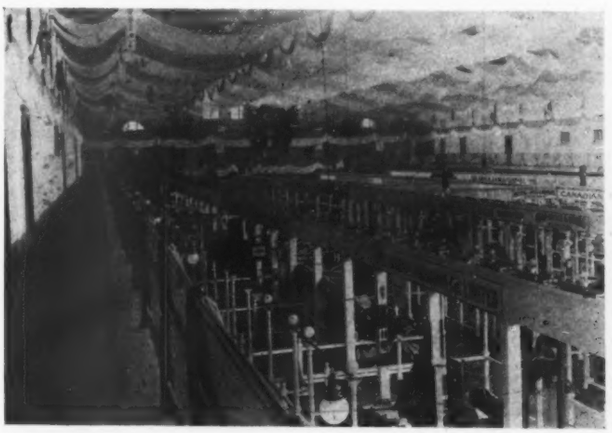


FIG. 2.—VIEW FROM THE GALLERY.

the bare filament and added materially to the lighting effect.

From an arched iron framework supported by the pillars were suspended 63 40-cp tungsten street series lamps. These gave a white light very similar to that of daylight. The lamps were operated nine in series on a 110-volt circuit. In the center of the booth were three holophane reflecting arcs or clusters consisting of six lamps each.

On the back wall was a case of miniature tantalum lamps ranging from 1.4 volts to 20 volts. A test board arranged for showing the relative power consumption of tungsten and carbon street series lamps demonstrated the vast superiority of the former in current consumption. A clever device was also in operation for showing the manner in which the high-efficiency tantalum lamps are less affected by a variation in voltage than the old style carbon-filament lamp.

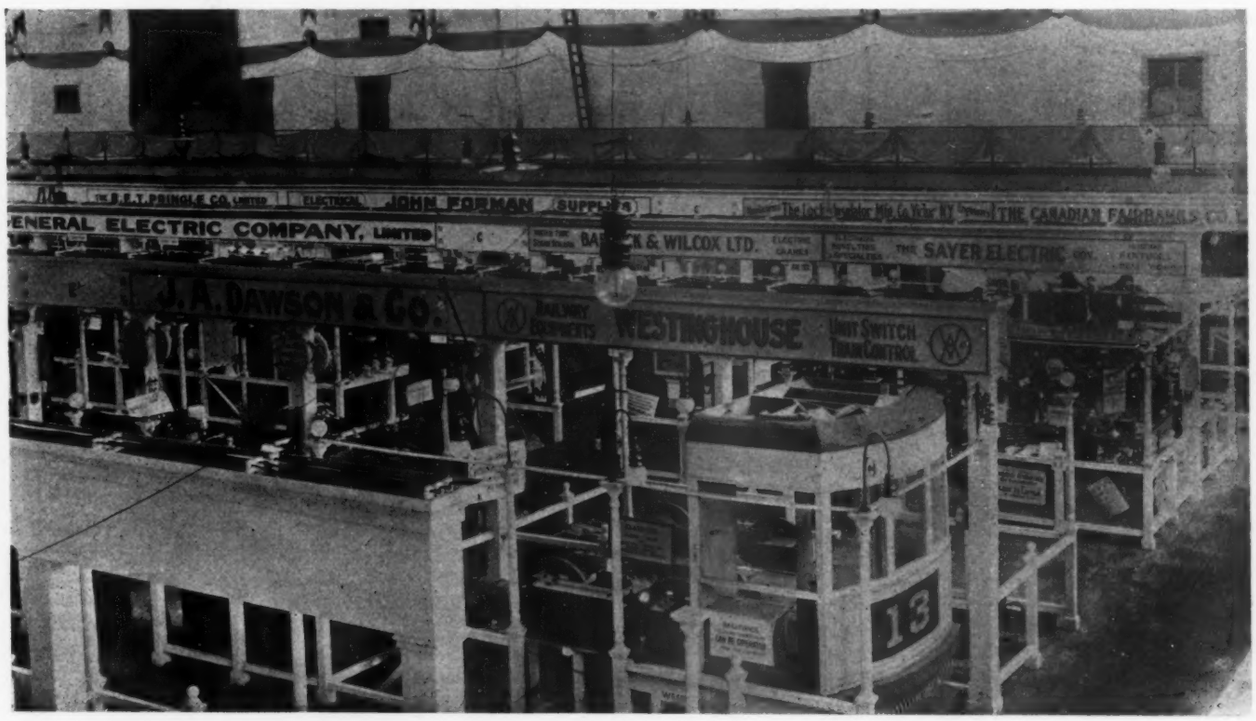


FIG. 1.—GENERAL VIEW OF CANADIAN ELECTRICAL SHOW, MONTREAL.

A large number of holophane globes and reflectors of various shapes and sizes arranged with lamps underneath, attracted considerable attention. In a darkened room especially constructed for the purpose, the increased downward light obtained by the use of holophane globes and reflectors was readily demonstrated.

One very interesting point brought out at this exhibit was the adaptability of the tantalum lamp for alternating circuit. All of the lamps were operated several hours per day on 110-volt, 60-cycle circuits without injury to the lamps.

Bulletins issued by the engineering department of the National

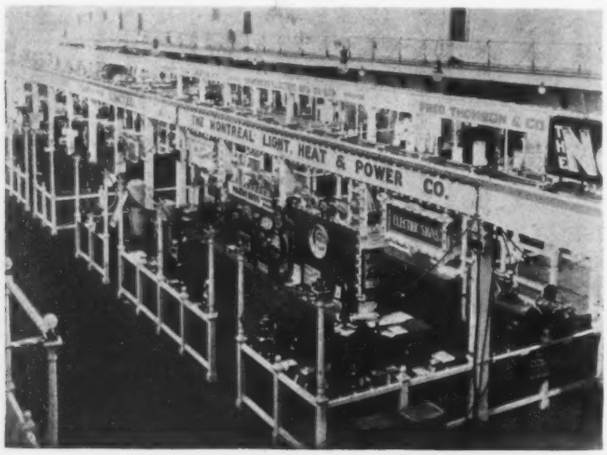


FIG. 3.—EXHIBIT OF MONTREAL LIGHT, HEAT & POWER COMPANY.

Electric Lamp Association, and dealing with progress on new lamps and modern illumination were placed in large quantities on tables and distributed to visitors.

Among the men to be seen around the booth were: Mr. B. T. Tremaine, of the National Association; Mr. S. E. Doane, chief engineer of the association; Mr. E. Irving, of the Canadian Sunbeam Company; Mr. V. R. Lansingh, of the Holophane Company; Mr. Geo. Loring, of the engineering department, besides several representatives of the engineering department of the Holophane and Sunbeam companies. The booth was in charge of Mr. Wm. Skiff, of the engineering department.

Fort Wayne Portable Wattmeter Calibrator.

The usual method of calibrating wattmeters by means of standard indicating instruments has the disadvantage of requiring the use of a stop watch and is, moreover, a time-con-

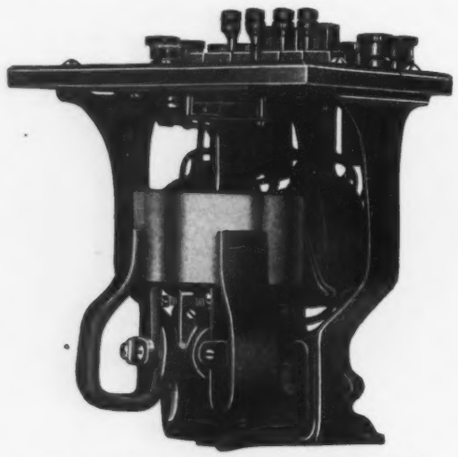


FIG. 1.—VIEW OF CALIBRATOR MECHANISM.

suming process which becomes unduly expensive where a large number of meters are in use. To meet the situation created by the present more systematic calibration of consumers' meters, the Fort Wayne Electric Works have placed on the market a portable wattmeter calibrator with which no stop watch is required except in standardizing the instrument itself, nor is it essential that the load be constant. It is only necessary to observe the revolutions of the meter under test and the pointer indications of the calibrator before and after test, from which, by the use of the proper constants, the watt-hours registered by the meter under test and the calibrator may be determined. The calibrator is so designed that it covers the range of most meters in service from light to full load, for either 110 or 220 volts, two or three-wire circuits. This is a desirable feature in that it saves carrying more than one standard.

As will be seen in the accompanying illustration, the calibrator is enclosed in a mahogany carrying case provided with a carrying strap for use in transportation. The register is located on the top of the calibrator so that the pointer indications can be read by the operator, at a distance if necessary, as

FIG. 2.—CALIBRATOR IN CASE.

in checking a meter installed close to the ceiling with the calibrator resting on the floor. The dial is 2¾ ins. in diameter and provided with three pointers, the larger of which reads directly in revolutions, being connected directly to the shaft, and which in turn drives the units and tens pointers. The periphery of the entire dial constitutes the tenths circle and is divided into ten large divisions, which in turn are subdivided into ten smaller divisions so that the pointer indications may be easily read to one-hundredths of a revolution. The units and tens circles are within the large circle, the former reading one revolution per division and the latter reading ten revolutions per division.

Directly in front of the dial is located a small knurled thumb screw by means of which the rotating element may be raised from the jewel and locked firmly in transportation. The rear section of the top of the calibrator constitutes the terminal plate to which all connections are made. On this plate are located four current binding posts to which the current coils of the calibrator are connected. On this plate are also located plug switches by means of which the current capacities of the calibrator may be changed. The current coils (two in number) are wound in sections which may be connected in series or series-parallel with the plug switches and in parallel on the plug switches in conjunction with the cable connectors on the current leads. Directly behind the plug switches are located the

potential receptacles, one for use on 110 volts and the other for use on 220 volts. These receptacles are provided with caps to prevent dust entering the interior of the calibrator when not in use. On this plate are also two, one-ampere fuses to protect the one-ampere winding from possible injury due to improper connections.

The entire calibrator may be lifted out of the case by removing the screw under the strap in the bottom of the case. The top plate is made of hard rubber in two sections, all of the connections being made on the rear section. This feature permits the removal of the register and rotating element without interfering with the connections.

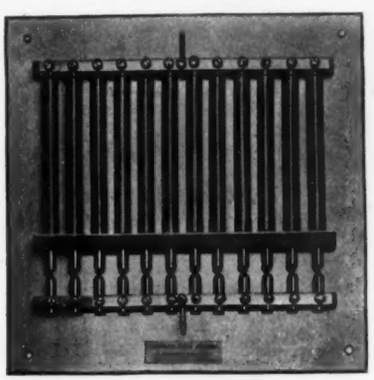
The windings selected as most suitable for meter testing are 1, 2, 5, 10 and 20 amperes and 110 and 220 volts. With these windings meters up to and including 25 amperes, two-wire, either 110 or 220 volts, and up to and including 12½ amperes, three-wire, 220 volts, may be tested. The ampere turns of all the windings are equal, therefore the torque is constant when the meter is operating on a given percentage of full load for any of the different windings.

In operation the calibrator is placed in a level position and the rotor lowered by means of a knurled thumb screw on the top. The rotor should always be raised in transportation. The current lead terminals should be connected to correspond with the stamped binding posts on the calibrator, these connections to remain the same for all circuits. The other terminals of the current leads are connected to the meter under test and the line, according to instructions furnished with each calibrator and pasted on the inside of the lid. Different current capacities are obtained by plug switches, which are fully explained in the instructions which go with the instrument.

After making the proper connections for calibrator and meter under test, a reading of the dial should be taken. The calibrator should then be started simultaneously with the counting of the revolutions of the meter under test and stopped after the desired number have been taken. A pendant snap switch connected to the potential leads is provided for this purpose. The difference between the first and last reading of the calibrator gives the total number of revolutions. The watt-hours registered by both meters is the product of the revolutions and their respective calibrating constants. These constants being the watt-hours registered per revolution, the relative accuracy of the meter under test is shown by the ratio of the watt-hours registered by the two meters. After the test has once been started it need not be stopped until the desired number of revolutions have been taken, as any change in the external circuit affects both the meter and the calibrator the same.

Lightning Arresters.

A new lightning arrester made by Campbell Brothers, of Traverse City, Mich., was exhibited at the Michigan convention.



MULTIPLE-DISCHARGE NON-ARCING LIGHTNING ARRESTER.

This arrester, known as the Gifford, is shown in the accompanying illustration. It consists simply of a number of multiple air-gaps in series with graphite rod resistances. The lower bus-bar, to which the lower discharge points are connected, is grounded. The line is connected to the upper discharge points and graphite rods. The theory of the arrester is that the resistance in series with the discharge points is sufficient to allow static discharges to pass over but not sufficient to cause an arc to follow after such a discharge has passed. The multiplicity of gaps is to provide two paths to earth to relieve the static discharge. It is claimed that it can be adjusted to discharge at a very small per cent above the line voltage.

New Instruments of D'Arsonval Type.

A new line of ammeters and voltmeters for direct-current switchboard use has just been placed on the market by the General Electric Company. These instruments, which are to be known as "Type D," are constructed on the D'Arsonval principle. A small coil of wire mounted on a light cylindrical aluminum frame is pivoted in jeweled bearings so as to move freely in a small annular space between a soft iron core and the pole pieces of a permanent magnet. These instruments are

FIG. 1.—VIEW OF INSTRUMENT WITH CASE REMOVED.

rendered dead beat by the Foucault currents generated in the aluminum frame as it passes through the field of the permanent magnet. This damping quality prevents injury to the pointer from violent load fluctuations and permits rapid and accurate readings as the pointer comes quickly to rest after each change in current value.

Accuracy is assured by the unusually high torque, light moving elements and the very small air-gap between magnet pole

FIG. 2.—VIEW OF INSTRUMENT COMPLETE.

faces and the iron core, combined with the permanency of the magnets which are made from the best obtainable grade of magnet steel and subjected to special processes of hardening and aging which fixes its magnetic characteristics. The round cast iron case which encloses the instruments protects it from the effects of stray fields and makes it dust-proof.

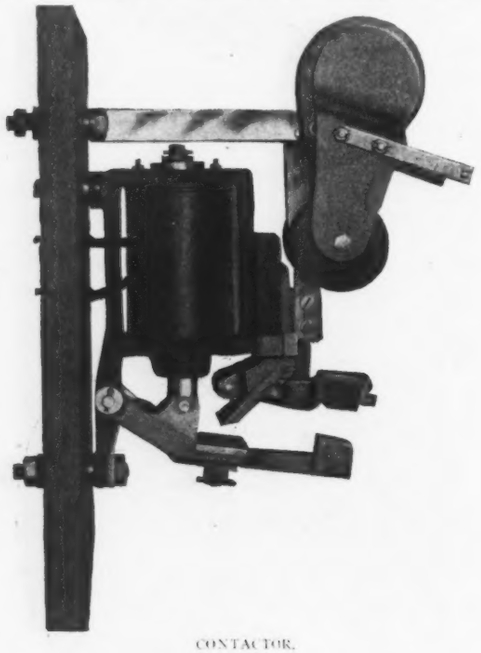
Inspection or repairs of these instruments is easily made.

The soft iron core together with the armature and jewel supports are assembled within the soft steel shell constituting the pole pieces. By removing the screws which hold the shell to the magnet pole faces, the entire mechanism may be removed. The scales are uniform throughout their entire range and very legible. The standard finish is dull black with raised portions polished copper, making a very pleasing and durable surface.

Type D voltmeters are made self-contained in capacities up to and including 750 volts. The ammeters are self-contained up to 60 amperes capacity. Larger capacities are furnished with external shunts which are made of a special alloy having practically a zero temperature coefficient. All instrument shunts above 1000 ampere capacity are now provided with a thermo-electric attachment. This attachment consists of a metal strip having one end electrically connected with one end of the shunt, with the other end in close thermal contact with the other end of the shunt, but insulated from it electrically. The ammeter leads are connected to the shunt and to the metal strip at the two insulated points. This prevents the superimposing of secondary thermoelectric currents upon the primary current, which is due to the fall of potential in the shunt and the amount of which fixes the value of the indication of the instrument. Ammeter shunts with this attachment are found free from temperature errors due to the generation of thermoelectric current.

Improved Contactor.

The Cutler-Hammer Mfg. Co., of Milwaukee, has recently placed on the market an improved type of contactor, shown in the accompanying illustration. These contactors are used for handling main-line currents where the nature of the service is severe. In such cases controllers employing sliding contacts cannot be relied upon to handle the main-line current, and it is customary to employ a controlling panel consisting of a number of contactors, this panel in turn being controlled by a



CONTACTOR.

master controller designed to regulate the secondary current which energizes the solenoids of the contactors.

The contactor illustrated is a compact and strongly constructed piece of apparatus, and is provided with an exceptionally powerful blow-out magnet. The main-line circuit is closed by the solenoid raising a pivoted arm carrying a thick copper plate, to a point where contact is made with a pair of stationary, laminated copper brushes. Arcing on this contact is prevented by providing an auxiliary copper and carbon contact in the field of a powerful blow-out magnet, which instantly extinguishes the arc incident to the breaking of the circuit. This auxiliary contact closes before the main contact is made and opens after the main contact is broken, thus effectually preventing any sparking on the main contact.

A noteworthy improvement is the pivoting of the blow-out shields, permitting these to be raised (as shown in illustration) so as to expose the auxiliary carbon and copper contact. In earlier types of contactors, these shields were rigidly fastened to their normal position, completely covering the copper and carbon contacts and rendering access to them difficult. The present construction makes renewal of either contact, or of the coiled spring (visible just above the carbon contact) a matter of a few moments only. The makers state that at a recent test at one of the largest Pittsburg steel mills a 220-volt circuit was opened and closed by a contactor of this type 88,000 times before renewal of the copper and carbon contacts became necessary, and—on a test to determine time required for repairs—the old contacts were removed and new ones inserted in less than two minutes.

Conduit Bender.

A conduit bender of extreme simplicity and of wide application is shown in the accompanying illustrations. As indicated in Fig. 1 it may be opened to receive the conduit, and hence no

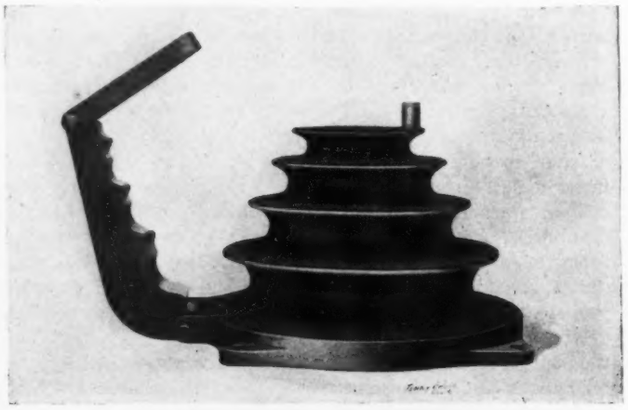


FIG. 1.—BENDER OPENED TO RECEIVE CONDUIT.

time is wasted in pushing the conduit through a tight-fitting hole. Its construction allows it to be used with the maximum of ease; being bolted on the top of the work-bench as seen in Fig. 2, the workman stands in a natural position and can ac-

FIG. 2.—CONDUIT BENDER IN USE.

complish the maximum of work. It is solidly built, and is practically indestructible. Conduit as large in diameter as 2 ins. may be used in the bender.

This bender has been placed on the market by the Glaze-Morris Manufacturing Company, 73½ East Long Street, Columbus, Ohio.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Among the favorable developments of the week were the increasing shipments of grain and flour for export. Further evidence of the increasing demand for our cereals was found in the weakening of foreign exchange and the reports that commercial bills against grain and cotton are appearing in larger volume. The crop outlook, as compared with recent years, is, on the whole, only fair. As the staple crops are secured and marketed there comes improvement in mercantile collections throughout the agricultural districts, and the decline in prices was especially helpful in stimulating export trade. In the several leading industries there were more irregular features, the most notable of which was the sharp break in copper prices. At the close of the week the United Metals Selling Company, which disposes of the product of the Amalgamated Copper Company, quoted electrolytic at 16½ cents. This is a reduction of 1½ cents from the price that was made ten days previous, when the cut from 22 to 18 cents was made. On July 9 the price was reduced from 25 cents to 22 cents. In spite of the latest cut there were no signs that the consumers were preparing to buy in quantity, and they were reported to be waiting for a further reduction of a cent or more. The closing prices were 16¼c. for Lake; 15¾c. for electrolytic and 15½c. for casting stock. In the iron industry there were reports of further shading of prices of pig iron at leading markets. Steel billets and sheet bars are scarcer and prices have hardened. Specifications on all finished material were heavy and the demand for structural material was fair. Building material is slow, despite increased buying of lumber at the West, and prices tend to ease. Building in August showed increased expenditures at a majority of cities, but losses at large cities result in a net decline from August, 1906, and July, 1907. August railway earnings point to a gain of at least 9 per cent over the same month a year ago. Reports by the Agricultural Department as to leading crops show lower conditions and smaller probable yields than in 1906. All cereal crops are below the ten-year average and the output of cereals this year is 14.4 per cent below that of 1906. Wheat yields promise to be 14 per cent smaller, corn 13 per cent and oats 18 per cent less than in 1906. Cotton conditions are below the ten-year average and are nearly equal to those of 1905 at this date. There are, however, 5,000,000 more acres in cotton this year than at that time. *Bradstreet's* reports 172 business failures during the week ending Sept. 12, against 130 in the previous week and 164 in the corresponding week last year.

ELECTRIC POWER IN COTTON MILLS.—The development of hydro-electric power along the Catawba River in South Carolina has already reached the point at which 67 cotton mills are operated by electricity generated at two power plants on this stream. These two plants have a capacity of 42,000 horse-power. Extensions will be added within a year to bring that up to 150,000 horse-power. An outlay of $12,000,000 is already planned. The lines now radiating from these power centers measure 253 miles in length. The cost of construction of these lines ranges from $6,000 to $7,000 a mile. On the North Carolina side of the line, on the Yadkin River, $5,000,000 are being spent on another plant, with an initial capacity of 5000 horse-power and a final capacity of 70,000 horse-power. Sixteen or seventeen plants are to be found in several Southern States, each using a thousand horse-power or more. One of these companies sells energy at the rate of $20 a horse-power a year.

ELECTRICAL IMPORTS AND EXPORTS.—The returns now available for May indicate that for the whole twelve months the electrical export trade will reach a new high level. During May the exports of heavy electrical machinery were $800,566, as compared with $681,955 last year. For the eleven months the total is $7,924,806, as compared with a previous $7,229,576 and $6,661,676 in 1905. The export of electrical instruments has shown a gratifying increase for the whole period, although May itself fell off somewhat. The exports of this class in May reached $619,393, while in 1906 they were $709,875. But for the eleven months they were $7,508,364, as compared with $6,115,254 and $4,490,818 in the periods corresponding of 1906 and 1905. For the eleven months, therefore, the total exports of electrical apparatus has attained the respectable figure of not less than $15,483,170, and it bids fair for the whole fiscal year to reach about $17,000,000.

THE COLUMBIAN ROPE COMPANY, Auburn, N. Y., will install an extensive new electric generating and motor equipment recently ordered from Allis-Chalmers Company, Milwaukee. The generator is to be a 940-kw, 60-cycle, three-phase machine, designed to operate at 120 r. p. m. Two 30-kw exciters are provided, one engine and the other motor-driven. The motors, all of which are standard Allis-Chalmers type, with bearings having sealed end boxes so designed as to exclude dust and flying particles of metal will be suspended from the ceiling. They include four 150-hp for 600 r. p. m., two 100-hp machines of the same speed, and a 20-hp motor with a speed of 900 r. p. m. This equipment includes three 40-kw transformers for use on the lighting system. A five-panel switchboard, built of Vermont blue marble, comprises three feeder panels, a generator and an exciter panel.

STEAM TURBINE FOR COTTON MILL.—The Cherry Cotton Mills, of Florence, Ala., have recently placed a contract with Allis-Chalmers Company, Milwaukee, covering a 500-kw steam turbine and alternator unit, together with turbo jet condenser and engine-driven exciter complete. The cotton mill industry of the South, which has known such phenomenal growth in the past decade, owes no small portion of its success to the use of electricity to drive its looms and spindles. The advantage of this method over the older line-shaft and belting are well known, resulting in saving of first cost of shafting, lower frictional losses, saving of power, labor and oil, and the possibility of easily securing a clean, well lighted mill, which insures the better health of operatives.

THE "LINOLITE" SYSTEM OF LIGHTING.—In our issue of June 1 appeared a description of the "Linolite" System of Show Window Lighting. This is an arrangement by which windows, show cases, etc., may be lighted with a continuous "line o' light" in the form of long tubular glow lamps with single filaments, placed behind a continuous reflector. We are now advised that the H. W. Johns-Manville Company, of New York, has recently secured the exclusive sales agency from the "Linolite" Company of America for the sale of this system in the United States and its possessions.

VERTICAL OIL ENGINE.—The De La Vergne Machine Company, East 138th Street, New York, is placing on the market a vertical type of oil engine. The company will continue the manufacture of the Hornsby-Akroyd, four-cycle horizontal oil engine, in size from 13 to 215 horse-power, and the new, or De La Vergne two-cycle engine is designed especially for the use of cheap oils, kerosene or fuel oil, and not for gas or gasoline. No carburetor or valve motion is used, the engine thus being one of the simplest ever devised.

NAVY PURCHASES.—The Bureau of Supplies and Accounts, Navy Department, Washington, will open bids Sept. 24 and Oct. 1 for electrical supplies, comprised in a number of classes, and including 4300 ft. of conduit, 200 dry cells, 500 Leyden jars, 241 bells, 10,000 carbons, 50,000 fuses, 4095 globes and shades, 11,700 incandescent lamps, 4240 switches and 1700 lbs. insulating tape. Applications for schedules of classes should be addressed to the above-mentioned Bureau.

COPPER.—A Boston despatch says: Consumers of copper are meeting the great falling off in new orders by restricting production. One manufacturer using 3,000,000 pounds of copper per month when running to full capacity is restricting production by running the plant but five days per week. Six months ago these mills were running nights.

CATALOGUES WANTED.—The Edgecombe Company, Cuyahoga Falls, Ohio, mechanical and electrical engineers, has added electrical contracting to its business, and desires to receive catalogues of electrical appliances and supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.—Various influences depressed the general stock list. Among these were the further decline in copper prices and reports that the mines of the Amalgamated Copper Company might be closed down. Heavy liquidation and short selling with severe breaks in Amalgamated and other copper stocks also had a weakening effect. Favorable developments were not lacking, however, embracing as they did the success of New York City bond subscription and the decision of the lower court in Pennsylvania against the constitutionality of the two-cent fare bill. Considerable activity developed in the New York City 4½ per cent bonds, which sold up to 103½ in the market after the allotment was announced. One of the features in later transactions was the renewal of bearish activity in the United States Steel shares. The argument in this connection was that the decline in copper and other metals might extend to the iron and steel industries. Some attention was paid to the position of the Philadelphia market which in the latter half of the week became decidedly demoralized with heavy liquidation and declines in local stocks, such as Philadelphia Rapid Transit and United Gas Improvement. Philadelphia Rapid Transit broke badly, losing 4½; Union Traction lost 7½ points and U. G. I. 2½. Toward the close of the week the New York market experienced a further bearish manipulation with renewed weakness followed, however, by a sharp rally at the end. The electric and traction stocks are all lower, with the exception of Metropolitan Street Railway, which recovered some of its recent losses to the extent of 3⅛ points net. No heavy declines are noted in the other stocks of these classes, the weakness being probably sympathetic. Following are the closing quotation of Sept. 17:

NEW YORK.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
Allis-Chalmers Co.	6	6¾	General Electric 127		123
Allis-Chalmers Co. pfd.	16	18	Hudson River Tel.....	—	—
Am. Dist Tel.....	20	—	Interborough Met. com.	8⅝	9
American Locomotive..	53	51¾	Interborough Met. pfd..	25	25½
Amer. Locomotive pfd..102		101	Mackay Cos.	64	63
American Tel. & Cable..75		75	Mackay Cos. pfd.....	64	62½
American Tel. & Tel...106		105	Marconi Tel.	—	—
Brooklyn Rapid Transit.	46¾	45¼	Metropolitan St. Ry....	37	41
Electric Boat	33	33	N. Y. & N. J. Tel.....100		—
Electric Boat pfd.....	80	80	Western Union Tel....	76	77
Electric Vehicle	—	—	Westinghouse com. 133		*136⅛
Electric Vehicle pfd....	—	—	Westinghouse pfd. 165*		—

BOSTON.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
American Tel. & Tel...106		106½	Mass. Elec. Ry. pfd....	50	49⅞
Cumberland Telephone.102		102½	Mexican Telephone	—	2
Edison Elec. Illum.....205		—	New England Telep.....	—	108
General Electric 127⅞		—	Western Tel. & Tel....	5½	5½
Mass. Elec. Ry.....	13	13	West. Tel. & Tel. pfd...	—	67

PHILADELPHIA.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
American Railways 46½		46½	Phila. Electric	7¾	7⅝
Elec. Co. of America...	9	8⅞	Phila. Rapid Transit...	19¾	19¼
Elec. Storage Battery...	45	45	Phila. Traction	90¼	88
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Sept. 10	Sept. 17		Sept. 10	Sept. 17
Chicago City Ry.....150		—	National Carbon	—	—
Chicago Edison	—	—	National Carbon pfd...	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....	—	—	Union Traction pfd....	—	—
Metropolitan Elec. com.	22	—			

*Asked.

UNITED STATES TELEPHONE.—The increase in gross earnings of the United States Telephone Company for July is small and the amount is more than taken up in the increased expenses. It is believed that the action of the company in dispensing with night rates will result in increasing the earnings materially and that the report for September and the months following will make a much better showing. The figures, as compared with those of July, 1906, are as follows:

	July, 1907.	July, 1906.	Increase.
Gross revenue	$35,498.24	$33,922.78	$1,575.46
Expenses	14,400.43	12,883.74	1,516.69
Net revenue	$21,097.81	$21,039.04	$58.77
Fixed charges:			
Bond interest	$8,983.33	$8,983.33	
Dividend, preferred stock.....	1,816.00	1,816.00	
Interest and expenses.....	1,006.43	389.57	$616.86
Taxes, leased lines and contracts, depreciation, etc.	2,058.56	2,104.12	*45.56
Total fixed charges.....	$13,864.32	$13,293.02	$571.30
Surplus	$7,233.49	$7,746.02	*$512.53
Less application to dividends on common stock	5,000.00	5,000.00	
Net surplus	$2,233.49	$2,746.02	$512.53

*Decrease.

DIVIDENDS.—Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock, and the regular semi-annual dividend of 1½ per cent on the common stock, both payable Oct. 15. The board of directors of the St. Joe Railway, Light, Heat & Power Company declared a regular quarterly dividend of 1¼ per cent on preferred stock, payable Oct. 1. The directors of the Cumberland Telephone & Telegraph Company have declared the regular quarterly dividend of 1¾ per cent, payable Oct. 1. The directors of the Western Union Telegraph Company have declared the usual quarterly dividend of 1¼ per cent. The directors of the Nebraska Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable Oct. 10. The directors of the Manila Electric Railroad & Lighting Corporation have declared a dividend of 1 per cent, payable Oct. 1.

BOSTON EDISON.—The annual report of the Edison Electric Illuminating Company, of Boston, for the year ended June 30, 1907, compares as follows:

	1907.	1906.
Gross	$4,020,620	$3,780,911
Expenses	2,591,823	2,443,286
Net	$1,428,797	$1,337,625
Other inc.....	41,340	49,256
Total net	$1,470,137	$1,386,881
Interest	176,451	92,170
Balance	$1,293,686	$1,294,711
Dividend	1,304,283	1,148,810
Surplus def.....	$10,597	$145,901
Previous surplus	213,409	67,508

HYDE PARK ELECTRIC LIGHT COMPANY.—The Hyde Park Electric Light Company, owned by the Massachusetts Electric Companies, has filed its annual report with the Massachusetts Gas Commissioners for the year ending June 30, 1907, which compares as follows:

	1907.	1906.
Gross income	$107,176	$108,265
Expenses	79,241	66,025
Net	$27,925	$42,240
Dividends	20,125	23,000
Surplus	$7,810	$19,240

NORTHEASTERN TELEPHONE COMPANY.—A despatch from Portland, Maine, states that the Northeastern Telephone Company, one of the largest independent companies in New England, is defendant in an equity action brought in the Supreme Court Sept. 9, with a view to securing a receivership. The petition was filed by the Portland Trust Company in behalf of the bondholders. It is stated that the company has twice defaulted its semi-annual payment of interest on its $600,000 bonds. The company has 7000 subscribers and operates about 10,000 miles of wire, including 300 miles of long distance lines in Cumberland, Sagadahoc, Androscoggin, Oxford, Franklin and Kennebec counties.

NORTH GEORGIA ELECTRIC COMPANY.—According to a despatch from Atlanta, Ga., Sept. 11, two suits have been filed in the United States Court there against the North Georgia Electric Company, one for a receiver and the other that the company be adjudged bankrupt. The suit for a receiver was brought by John A. Nesbit, of Zenia, Ohio, who alleges that the defendant owes him $5,000 on a promissory note. The company has secured franchises to enter Atlanta, but has not availed itself of that right.

LONG ACRE LIGHT & POWER COMPANY.—The Department of Water Supply, Gas and Electricity, New York City, has issued permits to the Long Acre Electric Light & Power Company for the distribution of its wires throughout the borough of Manhattan. The company will immediately begin construction work and expects to be able to supply light and power to the Long Acre Square district within sixty days.

WORCESTER ELECTRIC LIGHT COMPANY.—The annual report of the Worcester Electric Light Company filed with the Massachusetts gas and electric light commission shows a dividend of 8 per cent last year. The gross earnings for the year are given as $307,532, against $306,019 in 1906, a gain of $1,513. The gross receipts in 1905 were $294,459, showing a gain in 1907 from two years ago of $13,073.

U. S. INDEPENDENT TELEPHONE.—The reorganization committee of the United States Independent Telephone Company has issued a statement from Rochester, N. Y., to the effect that that all of the heaviest bondholders have assented to the proposed reorganization plans.

GENERAL NEWS

Construction News.

DOTHAN, ALA.—It is reported that R. Tillis, of Montgomery, is interested in a project to build an electric railway from Geneva to Dothan via Hartford and Slocomb.

MAGNOLIA, ARK.—The plant of the Magnolia Ice & Electric Company was recently destroyed by fire, causing a loss of $20,000.

OLA, ARK.—The Ola Lumber Company is considering the question of installing an electric plant to furnish electricity for lighting the town.

BISHOP, CAL.—Work on the power plants and dam of the Nevada-California Company on Bishop Creek is progressing rapidly. The additions to the old power house have been completed, increasing the capacity of the plant one-third. The company is constructing a new power house two miles below the present plant and will soon commence work on another, two miles above the old plant. Machinery and material for the plant has been ordered. The present plant has a capacity of 6000 horsepower, and the combined capacity of the new plants will be 8000 horsepower. The company will soon furnish electricity to operate the mine trolley system for handling ore at the mine of the Pittsburg Silver Peak Company, of Blair.

FRESNO, CAL.—The San Joaquin Power Company is making arrangements to increase the capacity of power plant No. 1 from 2500 to 12,500 horse-power.

HANFORD, CAL.—Application has been made to the Board of Trustees by S. F. Granger for a street railway franchise.

OAKLAND, CAL.—A. W. Maltby, of Concord, is interested in a project to construct an electric railway from the terminus of the Key Route at Claremont through the Berkeley Hills to Lafayette, Walnut Creek, Concord and Byron.

OAKLAND, CAL.—Plans have been completed by the Western Power Company for the erection of its power plant in this city, which is to be the main auxiliary to the company's power plant on the Feather River. The plans adopted contemplate a building 250 feet long and 100 feet wide. It is proposed to install turbine generators of 5000 horse-power, besides the necessary steam generating plant. In eight months the plant will supply 50,000 horse-power, and by Oct. 1 50,000 horse-power will be transmitted from the plant at Great Bend on the Feather River, a distance of 140 miles. Contracts have been placed for turbines, generators, boilers and all other machinery required. The cost of the auxiliary plant is estimated at $2,500,000.

SAN JOSE, CAL.—The National Park Electric Company has practically completed surveys for the development of 50,000 horse-power on the Toulomne River. The company contemplates an expenditure of between $4,000,000 and $5,000,000 in construction of power plants and transmission lines. A. C. Kuhn, Charles J. Kuhn, Ralph Hersey, Charles Quilty, of San José, and B. P. Oliver, of San Francisco, are interested in the enterprise.

SISSON, CAL.—The Southern Pacific Railroad Company, through Assistant Chief Engineer Wood, has announced that it would build a large dam on the Klamath River, near Chase's place, and install an electrical power plant to operate its trains over the Siskiyou Mountains by electricity.

VISALIA, CAL.—The Mount Whitney Company, which operates in the Visalia, Tulare and Porterville district, is planning to increase the capacity of its 1200-hp plant to 3200 horse-power.

BUENA VISTA, COL.—It is reported that Charles A. Reiss, of New York, N. Y., is interested in a project to build an electric railway to reach the rich mineral district across the continental divide west of Buena Vista, known as Taylor Park.

NEW HAVEN, CONN.—Work has commenced on the construction of the Shore Line Electric Railway, which is to run from Stony Creek to Saybrook. The road is 28 miles long and will make a continuous route from New Haven to Saybrook. W. C. Jones and Leonard T. Sanders, of New London, and A. W. Sperry, of New Haven, are interested in the enterprise.

NORWICH, CONN.—The incorporators of the Norwich, Colchester & Hartford Traction Company have organized with Costello Lippitt as president; Lucium Brown, secretary, and Henry W. Tibbitts, treasurer, of Norwich. The company has a charter to construct a street railway between Norwich and Hartford and is capitalized at $1,000,000. The length of the proposed line is 38 miles.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Sept. 24, to furnish at the navy yards and naval stations the following supplies: Boston, Mass., schedule 300—induction motor, etc. Charleston, S. C., schedule 300—motor drive; schedule 302—copper wire, electrical supplies, etc. New York, N. Y., schedule 296—electrical conductor, leyden jars, dry cells, receiver sets and insulators; schedule 299—junction boxes, electrical conductor; schedule 302—electrical conductor, brass and steel conduit, interior fittings. Washington, D. C., schedule 299—armature coils, electrical supplies, etc.; schedule 306—sheet copper machine and high-speed steel. Applications for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster General, U. S. N.

ST. AUGUSTINE, FLA.—The special committee appointed by the City Council to investigate the two bids submitted for lighting the city is said to favor the bid of the St. Johns Light & Power Company to light the city by electricity.

GAINESVILLE, GA.—Samuel C. Dunlap, of Gainesville, has been appointed temporary receiver of the North Georgia Electric Company. The company has just completed a 50,000-hp plant on the Chattahoochee River at Gainesville and a steel tower transmission line to Atlanta, Ga. It is said that the company owes more than $1,000,000, and that it has practically ceased all efforts to develop its water power. It is stated that $650,000 in bonds are outstanding.

MACON, GA.—The Bibb Power Company will soon begin construction work for the development of various water power properties. The company plans to develop 20,000 horse-power. It is understood that plans and specifications have been completed for building the dam on the Ocmulgee River. Charles F. Howe is chief engineer, and W. J. Massel, president.

SAVANNAH, GA.—Bids will be received until Oct. 15 by the Commissioners on Streets and Lanes (Harry Willink, director) for the illumination of the streets of the city by electric arc and incandescent lamps, and also to supply the city with electricity to be used for illumination, heat or power purposes.

BOISE, IDAHO.—At a meeting of the stockholders of the Boise & Idaho Interurban Railway Company held recently the old board of directors was elected. The company has decided to double track its road as far as Pierce Park, a distance of about four miles.

HAILEY, IDAHO.—The Cramer Electric Light Company is making arrangements to improve and increase the capacity of its plant to meet the increasing demands for electricity.

ALTON, ILL.—W. Rudsill, of Bunker Hill, has applied to the Village Board of East Alton for a franchise to build a street railway through that place. The line will run from Bunker Hill through Bethalto, Oil City and East Alton to Alton, a distance of 20 miles.

EARLVILLE, ILL.—It is reported that extensive improvements are to be made to the local electric light plant.

JACKSONVILLE, ILL.—The city is advertising for bids for a 200-kw generator and engine, 200 arc lamps, four transformers and arc regulators. Charles W. Brown is engineer in charge.

PINCKNEYVILLE, ILL.—A petition requesting the dissolution of the Pinckneyville Electric Light Company has been forwarded to the Secretary of State. The company has lighted the streets of Pinckneyville for more than ten years, but after the destruction of its power house by fire it decided not to rebuild. H. P. Huntsinger and H. E. Bincke were secretary and president, respectively.

CLAY CITY, IND.—A franchise and contract for lighting the city has been granted to B. M. Guirl, of Clay City.

CRAWFORDSVILLE, IND.—The County Commissioners will receive bids until Oct. 5 for installing a lighting plant at the county asylum. B. F. Corwin is county auditor.

EVANSVILLE, IND.—The County Board has ordered estimates to be prepared for lighting the county infirmary with electricity.

HARTFORD CITY, IND.—The United Telephone Company has decided to make improvements to its system in this city and county that will entail the expenditure of thousands of dollars for material and equipment. Several additional rural lines are to be erected.

PERU, IND.—A proposition is now before the City Council to sell the municipal electric light plant to a private corporation. If sold the purchasers will make improvements and install some new machinery.

PLYMOUTH, IND.—The Commissioners of Marshall County have ordered an election to be held Oct. 5 to vote on a subsidy proposition of $56,000 in aid of the construction of an electric railway through the county. The proposed road will run from Logansport to South Bend.

SEELYVILLE, IND.—Announcement has been made that Frank Fauvre, of Indianapolis, is to establish an electrical power plant near Seelyville.

SEYMOUR, IND.—Bids will be received until Nov. 1 for furnishing electricity for street and residential lighting and for power purposes; also for furnishing artificial gas for light and fuel. For further information address Frederick Everback, city clerk.

SUMMITVILLE, IND.—The Town Board is experiencing trouble with the municipal light plant. The plant was erected in 1902 and sold to the town for $55,000. The town has operated it since at a loss. The board has decided to separate it from the water works operation to determine the actual earning capacity of the plant. There is some sentiment favorable to the sale of the plant.

SYRACUSE, IND.—Plans are now being considered for enlarging the plant of the Syracuse Power, Light & Supply Company.

WARSAW, IND.—The City Council is determined to force the Warsaw Gas & Light Company to accept the terms of a new franchise submitted by the city. The franchise is to run 25 years and regulates the rates as well as the quality of the commodities. The company is owned and controlled by Detroit capitalists.

COALGATE, I. T.—The plant of the Coalgate, Lehigh & Phillips Electric Ice & Traction Company was totally destroyed by fire recently. The plant was located at Phillips, two miles south of Coalgate.

DAVENPORT, IOWA.—Plans are being made to construct a large water power plant on the Mississippi River above Davenport. F. H. Griggs is interested in the enterprise.

PRAIRIE CITY, IOWA.—The citizens have voted in favor of installing a street lighting system in the town.

CLAY CENTER, KAN.—The municipal electric lighting plant has been completed and is in operation. The plant will be in charge of the City Commission, which also has charge of the water works system.

PADUCAH, KY.—The Fairbanks, Morse & Company, of Louisville, have submitted a proposition to the fiscal court to install apparatus for a lighting and heating plant in the county court house and jail for $3,000.

COVINGTON, LA.—The St. Tammany Ice & Manufacturing Company is making extensive additions and improvements to its power station which, when completed, will greatly increase the capacity of the plant. E. J. Frederick is secretary and general manager.

AUGUSTA, MAINE.—The permanent organization of the Lewiston, Augusta & Waterville Electric Railway Company has been effected, and the following officers appointed: John R. Graham, of Bangor, president; H. L. Clark, of Philadelphia, Pa., vice-president; D. S. Hahn, of Lewiston, treasurer.

HOULTON, MAINE.—The stockholders of the Independent Telephone Company have voted to sell all the lines of the company to the Aroostook Telephone Company, a corporation controlled by the New England Telephone & Telegraph Company.

KEZAR FALLS, MAINE.—The Cornish & Kezar Falls Light & Power Company is installing an additional water wheel in its power station to increase the capacity of the plant.

CHESTER, MASS.—At a meeting of the citizens held recently a committee was chosen to present the present electric light conditions to the State Board of Electric Light and Gas Commissioners. The committee has asked the commissioners to authorize the fire district to install its own plant if terms cannot be made with E. Leroy Gardiner, owner of the local electric plant. Estimates are being secured to install a 50 or 100-light plant in the Riverside Inn. Mr. Packard states that he will not install a plant if the present plant can be secured or if the fire district installs another plant.

FALL RIVER, MASS.—The Board of Aldermen has decided to authorize the Mayor to enter into a contract with the Fall River Electric Light Company for lighting the streets of the city for a term of five years. By the terms of the contract the city secures a reduction from 30 cents to 25 cents per night for arc lamps, which amounts to a saving of about $15,000 a year over the contract now in force. The company will replace the present arc lighting system with new magnetite arc lamps.

FRANKLIN, MASS.—The Woonsocket Electric Machine & Power Company has submitted a contract to the Board of Selectmen for lighting the streets of the town. The company asks for a five-year contract and agrees to run transmission lines from its station in Woonsocket to Franklin, and to give 24-hour service, the work of the equipment of the same to be completed by July 1, 1908. The new contract is to be at practically the same rates as now paid by the town for lighting. The local electric plant will be discarded.

HOPEDALE, MASS.—The Milford Electric Light & Power Company is building a new transformer station in Hopedale and will install two 100-light self-regulating transformers. The street light service is to be increased by the installation of 42 additional incandescent lamps. W. C. Tewksbury is superintendent of the company.

ORANGE, MASS.—It is reported that a leading manufacturing concern of this town has secured an option on the water privilege at Eagleville, about two and one-half miles distant, and plans to install an electric power plant at that place to operate its shops.

PEABODY, MASS.—The A. C. Lawrence Leather Company is planning to erect a large power station at its Waters River plant.

MARSHALL, MINN.—The contract for the construction of the municipal electric lighting plant has been awarded to J. G. Robertson & Company, of St. Paul, Minn. Work on the construction of the plant will commence at once. The equipment of the plant will consist of two 200-kw, 3-phase, 60-cycle, 2300-volt, alternating-current generators, made by the Fort Wayne Electric Works; Ideal and Lane & Bodley engines having a capacity of 325-hp, and Brownell boilers of 400 hp. E. Simmons is superintendent.

MINNEAPOLIS, MINN.—Bids will be received until Sept. 24 by the Board of Charities and Correction (Richard Tattersfield, secretary), for the installation of electric wiring for the city workhouse. L. A. Lamoreau is the architect.

CAMPBELL, MO.—A. C. Morse, proprietor of the Campbell electric light plant, writes that he is contemplating installing a 150-kw alternator, a 150-hp Corliss engine, a tubular boiler of 150 hp and a 10-ton ice plant, and is planning to extend the lines to Piggott, Ark., to furnish electricity for street and general lighting purposes.

HERMANSVILLE, MO.—The plant of the El Dorado Electric Light Company, situated near the lake east of the town, was burned recently. There was no insurance.

JOPLIN, MO.—The Joplin-Pittsburg Railway Company will soon place contracts for machinery and equipment in connection with the electric railway it is now building between Joplin and Pittsburg, a distance of 24 miles. The company is also planning to build two substations, one at Chitwood and the other at Asburg, Mo., and also a car barn at Joplin.

MARYVILLE, MO.—The citizens at an election held recently, voted in favor of granting the Maryville Electric Light & Power Company a franchise for 20 years, and also voted to authorize the city to enter into a contract with the company for lighting the streets of the city for five years.

ST. JAMES, MO.—The temporary power house at the Soldiers' Home was recently destroyed by fire, causing a loss of $10,000.

ST. JOSEPH, MO.—The St. Joseph Railway, Light & Power Company is contemplating the construction of an interurban railway to Savannah, plans for which have been completed.

ST. LOUIS, MO.—The Board of Public Improvements, acting as a committee to consider specifications for the city lighting contract to be let soon, has agreed to separate the lighting contract from the proposition to grant a franchise for commercial lighting.

HARVARD, NEB.—E. V. Revell, of Giltner, is installing an electric lighting plant in this place. The equipment will consist of two 50-hp Olds gas producer engines and one 60-kw, 60-cycle, 2200-volt alternator made by the Lincoln Electric Company.

PENDER, NEB.—M. M. Newman is planning to put in a new electric plant in this place.

TABLE ROCK, NEB.—The capital stock of the Table Rock Telephone Company has been increased to $20,000.

CARSON, NEV.—Work will soon commence on the transmission lines of the California-Nevada Electric Power Company, which will extend from Pickle Meadows, near Bridgeport, Cal., to Tonapah and Manhattan, a distance of 220 miles. This extension will include transmission lines into Masonic, Bodie and Aurora. The company expects to be operating its lines into Reno and Yerrington within a year.

ATLANTIC CITY, N. J.—The City Council has granted the petition of the business men of Atlantic Avenue to light the streets with an incandescent lighting system from New Jersey to Florida Avenue, the cost of which is estimated at $12,000.

LINWOOD, N. J.—James Farish, borough clerk, writes that the ordinance passed recently by the Borough Council contains an agreement with the Pleasantville Electric Company to light the borough for a term of five years for $1,500 per year. The contract has not yet been signed.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company has been granted permission to lay rails and erect poles and wires along the county roads through Morristown.

CANASTOTA, N. Y.—The Central New York Power Company has completed its plant and is now furnishing electricity for lighting the streets of Canastota and the public buildings, and will extend its commercial power business as soon as warranted. The headquarters of the company are at Utica. Byron E. White is secretary and treasurer.

FREEPORT, N. Y.—The Village Board of Trustees has decided to install an all-night electric light service, which was voted upon by the taxpayers at the spring election.

NEW YORK, N. Y.—Bids will be received by James Stevenson, Commissioner of Bridges, until Sept. 26, for the construction and electrical equipment of the subway station tracks, and the electrical equipment of the elevated railway tracks of the Williamsburg Bridge, over the East River, between the borough of Manhattan and Brooklyn.

KERNSVILLE, N. C.—The Crews Manufacturing Company is contemplating installing machinery to generate electricity for lighting its mill.

LONG ISLAND, N. C.—The Long Island Cotton Mills, of which Osborne Brown is president, is planning to construct a dam at Buffalo Shoals in the Catawba River and to erect a power plant to transmit electricity to this place to operate its mills. The plant will cost about $30,000; 500 horse-power will be developed at first, which can be doubled when required.

NORTH WILKESBORO, N. C.—The local electric lighting system is being rebuilt and otherwise improved.

STATESVILLE, N. C.—The Turner Mills Company has awarded a contract to Ordway & Sons Company, of Winston-Salem, N. C., for the construction of a concrete dam at East Monbo, to develop power for the transmission of electricity.

McARTHUR, OHIO.—The citizens are contemplating enlarging the municipal electric lighting plant.

RAWSON, OHIO.—The question of establishing a municipal electric lighting plant is now being considered.

TROY, OHIO.—Bids will be received until Sept. 30 for $28,000 electric lighting bonds. Charles F. Rannalls is city auditor.

PORTLAND, ORE.—The directors of the Oregon Electric Company have authorized the construction of a branch line from Portland to Hillsboro, for which surveys have been located, franchises obtained, etc.

LANCASTER, PA.—The Lancaster, Oxford & Southern Railway Company has decided to convert its line from steam to electricity. Power for operating the road will be obtained from the plant at McCall Ferry. W. M. Franklin is president of the company.

STEWARTSTOWN, PA.—The new electrical plant at Ebaugh's mill on the east branch of Deer Creek, near Stewartstown, is about completed and will be ready to be put into operation in a short time. The plant will furnish electricity to the residents of Stewartstown, New Freedom, Railroad and New Market, Md. Warren E. Fastnacht is electrician.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company is making arrangements to extend its lines to Franklin, Mass., to supply the town with electricity for street lighting and for general lighting and power purposes. It is said that the company is planning to enlarge its plant to almost double its present size. George Batchelor is president of the company.

FLORENCE, S. C.—The city is considering the question of holding an election to vote on the proposition of issuing $25,000 in bonds for the construction of an electric light plant.

WARE SHOALS, S. C.—C. R. Willard & Company, of Spartanburg, S. C., have been awarded the contract to build two dams for hydro-electric power development, one at Ware Shoals and the other at Brown's Mills, seven miles from Ware Shoals, the first to cost approximately $75,000 and the second about $50,000.

CLARKSVILLE, TENN.—Mayor Northington has issued orders to City Engineer S. R. Alexander to remove from the business part of the city the poles and wires of the Cumberland Telephone & Telegraph Company, in accordance with the ordinance passed by the City Council last December. The company has refused to comply with the ordinance, intimating that the order would be fought out in the courts.

HENDERSON, TENN.—The local electric light plant, which has not been in use for some time, has been purchased by S. C. Rush. Improvements will be made to the plant and a 50 to 60-kw alternator, transformers and other machinery will be installed.

DALLAS, TEX.—The Dallas Traction Company is advertising for bids for the construction of the four substations to be built along the line of the electric interurban railway now under construction between Sherman and Dallas. The substations are to be located at Dallas, Plano, Van Alstyne and Sherman.

GROVETON, TEX.—The Groveton Light & Ice Company is planning to install an electric light plant in connection with its ice plant. John R. Collins is president and general manager.

ORANGE, TEX.—The City Council has entered into a contract with the Orange Ice, Light & Water Company to operate the city water works system for a term of 20 years. The company agrees to erect a standpipe not less than 90 feet in height and make other improvements. All extensions to the system are to be made at the expense of the company and paid for by the city at the termination of the contract. The Mayor was also authorized to make a contract with the company for ten additional arc lamps to be placed on the streets of the city.

PALESTINE, TEX.—W. B. Johnson and George R. Cooke will soon apply to the City Council for a franchise to erect a new electric light and power plant in this city.

MURRAY, UTAH.—The Progress Company of this place has filed a petition with the state engineer for 60 feet of water to be diverted from the Big Cottonwood. It is expected to develop 350 horse-power, which will be used to operate the Murray electrical system.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has decided to relinquish all its restrictions of the city's use of the power deeded to the city by the company in Big Cottonwood Creek by the 1905 franchise, provided the Council will pass its extension franchise and also validate the 1905 franchise and make it run for a period of 50 years.

BRISTOL, VA.-TENN.—Both municipalities of Bristol have granted a franchise to a new electric distributing company as a means of putting into effect the proposition of New York capitalists to spend $600,000 in developing the Holston River water power in order to supply Bristol with electricity for lighting and manufacturing purposes.

TACOMA, WASH.—The City Council has rejected the bid of George Milton Savage for the building of the Upper Nisqually River power plant at a cost of $1,750,000. The engineers recommend that the city immediately acquire land and water rights necessary for the installation of the power plant on the Upper Nisqually. They recommend the building of a power plant capable of generating 10,000 horse-power at a cost of $1,663,853, with a concrete-lined tunnel for a distance of a mile and a half through the rock on the west side of the river, in preference to a flume line without a reservoir.

ANTIGO, WIS.—Plans are being prepared by Thomas Orbison, of Appleton, engineer, for the development of the water power at Gardiner on the Wolf River. It is said that from 3000 to 5000 horse-power is available.

Company Elections.

BANGOR, MAINE.—At the annual meeting of the Rockland, Thomaston & Camden Street Railway Company held recently the old board of directors was re-elected as follows: George B. Macomber, president; A. D. Bird, treasurer; G. B. Macomber, John F. Hill, S. M. Bird, W. S. White and W. T. Cobb, directors.

QUITMAN, GA.—At a meeting of the stockholders of the Quitman, Valdosta & Thomasville Electric Railway Company held recently the following directors were elected: A. C. McLeod, O. K. Jelks, Frank Spain, L. W. Branch, S. S. Bennett, J. D. Wilson, H. L. Young, R. B. Young and E. C. Bridges. The directors elected officers as follows: A. C. McLeod, president; H. L. Young, vice-president, and J. J. Jelks, secretary and treasurer.

New Industrial Companies.

THE MILLER ELECTRIC COMPANY, of Terre Haute, Ind., has incorporated to establish and equip a plant for the manufacture of electrical machinery and electrical supplies. Frank B. Miller is president and J. W. Miller, secretary.

THE NATIONAL TRADE TAPPER COMPANY, of Bangor, Maine, has been organized for the purpose of manufacturing and dealing in electrical appliances of all kinds. The company is capitalized at $10,000 and the officers are: Charles L. Snow, president, and Arthur J. Waterman, treasurer.

THE POWER MACHINERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,500. The directors are M. E. Berger, R. J. Walsh and J. H. Crawford.

New Incorporations.

DOUBLE SPRINGS, ALA.—The Winston County Telephone Company has been organized with a capital stock of $5,000. Dr. C. A. Olivett, of Addison, is president.

CLAYTON, ILL.—The Clayton Farmers' Union Telephone Company has been incorporated with a capital stock of $1,000 by John W. Wallace and others.

EL PASO, ILL.—The Panola Independent Telephone Company has been incorporated with a capital stock of $525 by Joseph Haas, James Bailey and others.

INDIANAPOLIS, IND.—The A. P. Fox Specialty Company has filed articles of incorporation for the purpose of manufacturing special supplies, etc. The capital is $100,000, and the directors are A. P. Fox, V. A. Smith and Henry Reitz. The company proposes to erect and equip a plant with engines, electric appliances, machinery, etc.

TERRE HAUTE, IND.—The Miller Electric Company has been chartered with a capital stock of $10,000 by Frank Miller and others.

SVEA CITY, IA.—The Farmers' Central Telephone Company has been incorporated with a capital stock of $420 by C. H. Giles and others.

EDMOND, KAN.—The Edmond Southwestern Telephone Company has been incorporated with a capital stock of $1,800 by E. M. Pettegrew and others.

JERSEY CITY, N. J.—The Frontenac Gas Company has been incorporated with a capital stock of $10,000 for the purpose of doing gas and electric lighting business. The incorporators are C. N. Jelliffe, C. R. Barlett and Edward Ostrom, Jr.

RICEVILLE, N. Y.—The People's Mutual Telephone Company has been incorporated with a capital stock of $10,000 by Jesse Martin and others.

HICKORY, N. C.—The Horseford Power Company has been chartered with a capital stock of $125,000. A. A. Shuford is interested in the company.

WINSTON-SALEM, N. C.—A charter has been issued to the Midway Telephone Company for the construction and operation of a telephone line from Midway to Winston-Salem. C. E. Snider is one of the incorporators.

TOLEDO, OHIO.—The Citizens' Lighting & Heating Company has been incorporated with a capital stock of $200,000 by Charles S. Ashley, William S. Walbridge, J. W. Schaufelberger, J. W. McMahon and G. W. Kinney.

LOGAN, OKLA.—The Logan Telephone Company has been incorporated with a $50,000 capital stock. The directors are Frank Wentworth, J. Thompson and Samuel Smith, all of Logan.

DU BOIS, PA.—A new company has been organized under the name of the United Traction Street Railroad Company, of which Austin Blakeslee is president and M. I. McCreight secretary and treasurer. The electric railway system is to be extended to Big Run. Steps will be taken at once to secure the charter, and the directors have been directed to purchase rails and supplies. As the road is now planned it will not be necessary to construct but about three miles of the road, as it is the intention of the company to use the old B. R. & P. tracks for the greater part of the distance.

LEXINGTON, TENN.—The Broadway Home Telephone Company has been organized in this county. It is capitalized at $5,000. A line will be run from this place to Juno. The officers of the company are: J. Hawthorne, president; F. M. Evans, secretary; Rev. A. H. Insco, treasurer. An exchange will be established in Lexington and will be in operation Oct. 1.

ROANOKE, VA.—The Rural Power Company has been chartered with a capital stock of $5,000. The company proposes to develop power plants in the county. P. B. Huff is president.

BLAINE, WASH.—The Blaine Water & Power Company has been incorporated with a capital stock of $50,000 by J. J. Crites and others.

EVERETT, WASH.—The Everett & Cherry Valley Traction Company has been organized with a capital stock of $1,500,000 by J. T. McChesney and others.

WHEELING, W. VA.—The Interurban Railway Company has been chartered with a capital stock of $10,000 to build an electric railway from Wheeling to Bethany.

ONTARIO, WIS.—The Brush Creek Farmers' Telephone Company, Ontario, Vernon County, has been incorporated with a capital of $3,000 by I. O. Hoff and others.

PRAIRIE DU SAC, WIS.—The Legislature at Madison has granted articles of incorporation to a company which proposes to construct a dam across the Wisconsin River at Pounds Landing, about 1 mile north of this village. Magnus Swanson, of Madison; J. S. Tripp, of Prairie du Sac, and M. A. De Vitt, of Chicago, Ill., are interested. The dam is to be constructed in connection with the power plant at Kilbourne, and is to furnish electric energy for nearby cities and towns extending as far as Madison, Janesville and Beloit. The plant will have a capacity of about 9000 kw.

PRENTICE, WIS.—The Prentice Light, Power & Water Company has been incorporated with a capital stock of $3,000 by A. F. Zeigler and others.

UNITY, WIS.—Articles of incorporation have been filed for the Strum Telephone Company by S. B. Anderson and others. The company is capitalized at $8,000.

Legal.

ACTION FOR DAMAGES FOR DEATH BY CONTACT WITH LIVE WIRE.—In an action against the Western Union Telegraph Company to recover damages for the death of a trimmer in the employ of the Northern Electric Light Company the following facts were shown: An unused telegraph wire, which it was alleged belonged to the defendant or was under its control, fell across an electric light feed wire of the Northern Electric Light Company. The telegraph wire had been connected with a call box which had been removed some months before the accident. The wire had fallen three or four weeks before. One end of it extended down so near the pavement that children reached and played with it. The other end was wrapped around an iron pole. The deceased was a trimmer in the employ of the electric light company and was killed by an electric shock while engaged in placing carbons in a lamp attached to the pole. It was held that the plaintiff was entitled to recover and that a judgment in his favor would not be reversed. Mannenhower vs. Western Union Telegraph Company, Supreme Court of Pennsylvania, 67 Atl. Rep. 207.

ARMATURE CORE PATENT LITIGATION.—The United States Circuit Court for the District of New Jersey has filed an opinion in the suit of the Westinghouse Electric & Mfg. Company against the Prudential Insurance Company of America, on Nolan patent No. 582,481, granted May 11, 1897. This opinion is the outcome, after the hearing of testimony of both sides and argument at final hearing, of a suit brought by the Westinghouse Company against the Prudential Company, charging the latter with infringement of Nolan patent No. 582,481, in a generator manufactured by the Bullock Electric Manufacturing Company, of Cinnati, Ohio. The Nolan patent in suit relates to a means for fastening the laminæ of the cores of electrical machines together and to the casting by which they are supported, and whereby the armature can be readily taken apart and put together. The laminæ are clamped between a cylindrical flange at one end of the casting and a ring fitting over the other end of the casting. This ring is held in place by a small fastening ring interposed between it and a small shoulder on the casting. A shoulder is provided upon the outer face of the clamping ring for holding the small ring from flying outward. This is generally termed the spring-ring method of clamping armature laminæ. Judge Lanning in this opinion holds that claims 2 and 4 of the Nolan patent are valid and cover the construction found in the Bullock generator used by the Prudential Company.

CONTRACT TO GIVE TELEPHONE COMPANY EXCLUSIVE RIGHT TO MAINTAIN TELEPHONE EXCHANGE IN HOTEL HELD INVALID BECAUSE IN RESTRAINT OF TRADE.—The Central New York Telephone & Telegraph Company entered into a contract with the proprietors of the Yates Hotel in Syracuse, N. Y., by which it agreed to install a telephone exchange in the hotel with its appropriate switchboards, wires and tubing. In consideration of this agreement the hotel proprietors were to furnish certain space and accommodation for the booths and appliances of the telephone company, were to pay a certain compensation and were to give the company exclusive right to place telephones in the hotel. The proprietors threatening to violate this contract by removing the system and by installing therein the system of a rival corporation, an action was brought and a temporary injunction was obtained. The matter presented for consideration was the validity of the agreement to allow one telephone company an exclusive right to maintain its instruments in the hotel and the only ground upon which the contract was attacked was that it was void because in restraint of trade. It was held that the contract in question was void and that the proprietors of the hotel might disregard it to the extent of negotiating with any other telephone company as they should see fit. Central New York Telephone & Telegraph Company vs. Averill, New York Supreme Court, 105 N. Y. Supp. 378.

RIGHT OF DEFENDANT ELECTRIC COMPANY TO HAVE QUESTION OF LIABILITY DETERMINED BY THE JURY.—In an action for damages against an electric company it was shown that the plaintiff had been employed by the defendant as a cable splicer or electric plumber. He was taken from his work, which was done mainly in underground conduits, and directed to assist in the removal of an iron pole, which had rusted near the base and become unfit for use. This was work with which he was not familiar. The pole had been inspected and condemned as unsafe, but of this fact he had no knowledge. The defects were not apparent nor discernible except by inspection. He supposed the pole was safe, as it appeared to be, and from information received from the foreman believed that it was to be replaced by one of a different kind. While he was at the top of the pole assisting in the removal of a mast arm the pole broke a few inches from the ground because it was too weak to sustain the extra weight. This testimony, although flatly contradicted, made out a case that entitled the plaintiff to go to the jury, since it tended to show that there was a special risk in the work which was not patent and was not known to him, but was known to his employer. But it was held that it was improper for the trial judge to direct the jury to find for the plaintiff and a verdict brought in on such a direction was reversed. Crothers vs. Philadelphia Electric Company, Supreme Court of Pennsylvania, 67 Alt. Rep. 206.

RIGHT OF FOREIGN TELEPHONE COMPANY TO EXERCISE THE RIGHT OF EMINENT DOMAIN IN THE STATE OF MISSISSIPPI.—Section 925 of the 1906 Mississippi Code provides that all companies or associations of persons incorporated or organized for the purpose of constructing telegraph or telephone lines shall be authorized to construct the same along and across any of the public highways, railroads, and section 929 empowers them, for the purpose of constructing new lines, to exercise the power of eminent domain as provided in the statutes on that subject. But section 1876, in the chapter on eminent domain, provides that telephone companies "chartered under the laws of this state" may acquire a right of way "across" railroads and does not mention foreign companies. Counsel for the Yazoo & Mississippi Valley Railroad Company, along which the Cumberland Telephone & Telegraph Company desired to lay out a right of way, argued that, as section 1876 provided for domestic corporations only, the Cumberland company, being the creation of the state of Kentucky, had no power to proceed by eminent domain. The court concluded, adversely to this contention, that the first two sections mentioned must be given effect, as well as section 1876, and that as those sections did not discriminate between domestic and foreign companies, the Cumberland company had the right to erect its line along right of way of the Yazoo Railroad. Cumberland Telephone & Telegraph Company vs. Yazoo, etc., Railroad Company, 44 So. Rep. 166.

ACTION FOR DAMAGES BY MOTORMAN INJURED BY EXPLOSION OF THE CONTROLLER ON A STREET CAR.—A motorman who is injured by an explosion in the controller cannot establish a right to damages against the company by showing merely that such an explosion occurred. He must further show in order to entitle himself to damages that the company was in some way guilty of negligence. The evidence showed that plaintiff, David W. Sills, was a motorman on one of defendant's street cars; that while in the discharge of his duty on the front platform of the car there occurred an explosion of the controller which was so violent that Sills was thereby blown or thrown entirely off the car and he fell upon the pavement or sidewalk on the bridge over which the car was passing at the time. He was unconscious when picked up and was found to have suffered painful injuries. Testimony was given that the controller was one of the best on the market and an expert testified that the makers of such machinery have been unable to make it absolutely perfect and that accidents and derangements take place from time to time in spite of all they can do. It was held that the company was not required to furnish its servant absolutely safe appliances or machinery with which to work, but had discharged the full measure of duty toward the servant when ordinary and reasonable care had been exercised to supply and maintain safe machinery, tools and appliances with which to do the work. Beebe vs. St. Louis Transit Company, Supreme Court of Missouri, 103 S. W. Rep. 1012.

ACTION FOR DEATH BY CONTACT WITH TELEPHONE COMPANY GUY WIRE.—In the case of Snyder against Mutual Telephone Company, the usual order of parties is reversed, and we find the administrator of an employee of an electric light company bringing suit against a telephone company to recover damages for the employee's death, alleging that the same resulted from contact with a guy wire attached to one of the telephone company's poles. As a general rule, the action is against the electric light company for the benefit of the estate of the telephone company's employee, who has been killed as a result of coming in contact with a high-voltage wire belonging to the electric light or power company. The theory upon which the liability of the defendant telephone company was predicated, was that the telephone company was negligent in having an uninsulated guy wire connecting the light company's pole with the defendant's own pole across the street, with which the foot of the deceased came in contact while he was handling the live wire extending from the converter to the fuse box, thus grounding the light company's circuit of a high voltage and causing instant death. The chief contention of the defense with reference to the lineman's contributory negligence was that he should have worn rubber gloves which were provided by his employer for the handling of wires charged with a dangerous voltage. The testimony for the plaintiff tended to show a custom among the employees not to use such gloves in cold weather, as they prevented the wearers from using their hands effectively, and that it was regarded

efficient application of the heat and sufficient radiating surface so that nearly all the devices may be left in circuit indefinitely without fear of burn out.

Business Notes.

THE ELECTRIC CITY PUBLISHING COMPANY, Chicago, has moved its offices from the Edison Building to the Electric Block, 89 Market Street, where the entire second floor is occupied by the several departments of *The Electric City*.

THE U. T. HUNGERFORD BRASS & COPPER COMPANY, Pearl and Park Streets, New York, has nearly completed another warehouse for storing stock, known as warehouse No. 2, at 486-492 Pearl Street. The building, which occupies a site 100 x 127 feet, is of two stories and basement, and has a storage capacity of 5,000,000 pounds.

THE CONTINENTAL FIBRE CO., of Newark, Del., incorporated last year, reports such a demand for its product that it has already been necessary to double the capacity of its plant. These improvements are now about completed and the usually active fall trade will find the company equipped to make immediate deliveries in practically unlimited quantities. Each of the incorporators of this company has been connected with the vulcanized fibre business since its infancy. To this experience, together with sufficient capital and thorough organization offices, the company's success is attributed.

THE STANDARD UNDERGROUND CABLE COMPANY has reopened offices in San Francisco, in the Shreve Building, moving there from its temporary quarters in Oakland. Mr. A. B. Saurman continues as Pacific Coast manager. The new Oakland factory of the company is four times as large as the factory which was destroyed by fire shortly after the earthquake last year. It is as nearly fireproof as possible, and equipped with new up-to-date machinery for the manufacture on short notice of insulated wires and cables for practically any service. It is also equipped with complete warehouse facilities for handling the products of the Eastern factories carried in stock for Coast delivery.

HESS-BRIGHT MANUFACTURING COMPANY, Nineteenth and Hamilton Streets, Philadelphia, has just received the following letter from Glaenzer & Cie., its French representatives: "We have the pleasure to submit to you some matter that will permit you to judge of the last success due to our ball bearing D.W.F. (Hess-Bright) in the race for 'The Emperor's Cup' (Kaiserpreis). Of the first ten cars to arrive, seven had our ball bearings D.W.F. (HB). These ten cars belonged to six different makers, and five of these (Pipe, Opel, Isotta Fraschini, Itala and Mercedes), use D.W.F. (HB) ball bearings. The crankshaft of the Pipe was mounted on D.W.F. (HB) ball bearings." This, it is said, but repeats previous history, as practically every race of international importance has been run and won on HB—D.W.F. ball bearings.

FRANK B. COOK, of Chicago, reports the following as among orders recently secured for distributing boards and protectors: Omaha heads the list with 6000 pairs of protectors; Spokane, Wash., has an order in for 2500 pairs, and Edmonton, Canada, for 1000 pairs. The Tri-State Telephone & Telegraph Company, of Minneapolis, is installing an addition of 4720 pairs of Cook's protector and orders have also been received from the following: Alhambra, Cal., 300 pairs; Westfield, N. Y., 400 pairs; Seattle, Wash., 800 pairs; Lexington, Ill., 400 pairs; Wheeling, W. Va., 310 pairs; Oakland, Cal., 1000 pairs; Nebraska City, Neb., 700 pairs; Beaver Falls, Pa., 1000 pairs. The first order for terminals for Omaha has also been received, thus assuring the use of Cook protectors throughout the entire plant. The initial order is for 900 terminals, part of them being Cook's new porcelain type of terminal. Among other large orders for subscriber's station protectors are from the American Union Telephone Company, New Castle, Pa., 1000, and the Rochester Telephone Company, Rochester, N. Y., 1000.

THE HOLOPHANE COMPANY has recently augmented its sales force by the addition of Mr. Morgan P. Ellis and Mr. Harry P. Struben. The former comes from the Electric Appliance Company of Chicago and will travel the Northwestern States. Mr. Struben was, until lately, connected with the engineering department of the Pennsylvania Railroad Company, with headquarters at Baltimore. He will travel in the Southwest. The large number of gas and electrical engineers, architects and central station men who are becoming interested in illuminating engineering, and who call upon the Holophane Company for data in this branch, has led to the engagement of Mr. T. R. Pemberton, in the position of office salesman and demonstrator. The Holophane Company has a very complete demonstration room, in which the illumination value of its product is shown. The engineering department of the company has been increased by the addition of Mr. T. R. Rolfe, engineer, and Mr. C. W. Heck, designer. Mr. Heck resigned from the Safety Car Heating & Lighting Company to establish a department of special fixture designing for the Holophane Company, this department being necessary to take care of the growing number of large lighting installations being handled by the Holophane illuminating engineers.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 10, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

865,367. FLUORESCENT ELECTRIC LAMP; Thomas A. Edison, Llewellyn Park, N. J. App. filed May 19, 1896. Renewed April 29, 1902. A fluorescent screen or surface composed of tungstate of calcium, substantially as set forth.

865,368. SYSTEM OF ELECTRICAL DISTRIBUTION; Justus B. Entz, Philadelphia, Pa. App. filed Dec. 30, 1905. Relates to voltage regulator or system of distribution including a storage battery and its complementary booster. The booster has three field influencing coils in the load circuit, in the battery circuit and a third circuit opposing the first-mentioned coil.

865,377. AUTOMATIC SUSPENDING REEL FOR ELECTRIC INCANDESCENT LAMPS; John H. Gordon, Snoqualmie, Wash. App. filed Jan. 11, 1907. A hollow metallic drum is journaled between depending standards and has a spiral spring at one end by which it is normally wound up like a spring roller. The circuits are completed through the journal bearings.

865,379. COMBINED JACK AND RESTORING DROP; E. J. Grenier, Menominee, Mich. App. filed April 18, 1906. Construction having sector arm repeatedly movable to ordinal divisions.

865,383. CONTROLLING DEVICE; Arthur E. Handy, Providence, R. I. App. filed Dec. 31, 1904. A system of contactors separated by a single longitudinally movable rod impelled by a solenoid and controlled by a dash pot.

865,412. ATTACHMENT FOR ELECTRIC MOTOR CONTROLLERS; Albert H. Mathewson, Thompsonville, Conn. App. filed March 28, 1907. A mechanical arrangement for the handle of a motor controller, including inclined blades and balls which co-operate wherewith to insure a momentary stoppage at the notches of the controller when the current is being turned on.

865,470. PRINTING TELEGRAPH; John E. Wright, New York, N. Y. App. filed May 6, 1904. Improvements in that class of telegraph instruments which are used as receivers, and which print in columns of successive rows the letters corresponding to electrical impulses of definite number and character transmitted over the line.

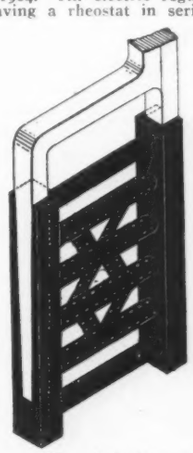
865,473. BREAK ARM FOR ELECTRIC WIRING; Walter A. Arthur, Manchester, N. H. App. filed April 5, 1907. A rigid cast iron bracket is clamped to the cross-arm of the telegraph pole and has means for supporting separate arms for a plurality of insulator pins whereby the line wires are secured and the branch line connections established.

865,474. TROLLEY; Joseph Ashurst, Chicago, Ill. App. filed March 25, 1907. In place of the usual trolley wheel patentee has a pair of vertically journaled rolls with the flanges at their lower end which receive the trolley conductor between them.

865,483. INSULATING COUPLING; Gustave F. Dreher, Schenectady, N. Y. App. filed April 9, 1906. A strain insulator comprising a T-shaped casting and C-shaped casting which interlock together, there being provided an insulating sheet between the two.

865,503. ELECTRICAL ACCUMULATOR; John Knobloch, New York, N. Y. App. filed Dec. 26, 1900. An electrical accumulator in which the anode and cathode elements are built up of a plurality of units. Has an element of pervious insulating support, secured to and surrounding the units and embracing the structural portion of the elements, together with lateral braces of insulating material to support the structure.

865,516. ELECTRIC REGULATOR; Frank C. Newell, Wilkinsburg, Pa. App. filed Oct. 22, 1904. An electric regulator comprising a main generating circuit having a rheostat in series, a second circuit for exciting the field of the generator and having one terminal connected to the main circuit, and a magnetically operated shiftable contact member for the rheostat constituting the other terminal of the second circuit.



865,503.—Electrical Accumulator.

865,527. HEATING DEVICE; Albert A. Radtke, Chicago, Ill. App. filed Oct. 27, 1906. A device for cooking eggs comprising a chamber of substantially the size and form to receive an egg and having a lining formed of a resistance element which can be put in an electric circuit by a local snap switch.

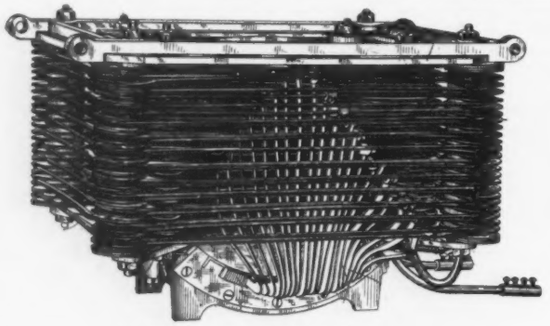
865,536. SELECTOR FOR AUTOMATIC TELEPHONE EXCHANGES. C. E. Scribner, et al. App. filed April 10, 1905. Renewed July 1, 1906. A selector comprising a number of connection terminals, a movable switch, a ratchet adapted in its movement to advance said switch into engagement with any one of said terminals, a rotatable shaft upon which said ratchet is mounted, a weight separate from

the rachet carried by the shaft to give said rachet inertia, a pawl adapted to engage the teeth of said ratchet, and a magnet adapted to rapidly oscillate said pawl to move the same from tooth to tooth on said ratchet to advance the same before the inertia thereof is overcome to allow the ratchet to begin a return movement.

865,567. FUSE PLUG; Robert C. Cole, Hartford, Conn. App. filed March 4, 1907. A fuse plug having a tubular conducting shell with one end formed for contact with a socket terminal and the other end formed of reduced diameter and adapted to receive the terminal of a cartridge fuse, in combination with an insulating covering surrounding said portion of reduced diameter.

865,588. ELECTRIC SWITCH; Edward M. Hewlett and Theodore E. Button, Schenectady, N. Y. App. filed Nov. 19, 1902. Relates to switches for handling large electric currents and provides means which will respond effectively to a controller device located at a distant point from the point of installation of the switching member, and connected thereto by a pilot circuit.

865,604. TARGET; August C. Meyer, Worcester, Mass. App. filed Jan. 4, 1906. A target of the type having annunciator mechanism in which the correctness of the aim of a firearm is indicated without



865,516.—Electric Regulator.

actually discharging the firearm. Includes a plurality of shutters with lever connections, operating magnets.

865,606. INSULATING MATERIAL AND METHOD OF PRODUCING THE SAME; Charles L. Norton, Manchester, Mass. App. filed Feb. 23, 1907. The process which consists in impregnating a porous body containing a free oxidizing agent, with a liquefiable, oxidizable hydrocarbon.

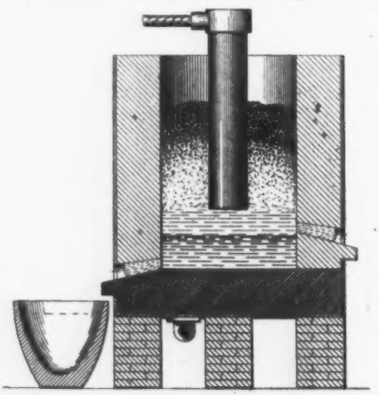
865,608. PROCESS OF BAKING CARBON ELECTRODES AND HEATING BY ELECTRICITY AND COMBUSTION; E. F. Price, Niagara Falls, N. Y. App. filed April 22, 1905. The process of baking carbon electrodes, which consists in initially heating the electrodes and a resistance conductor or conductors by combustion, and heating the hot electrodes to a higher current by passing an electric current through said conductor or conductors, as set forth.

865,609. PROCESS OF SMELTING REFRACTORY ORES AND PRODUCING LOW CARBON FERRO ALLOYS; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. Process designed for the production of ferrochromium and similar alloys, using ferrosilicon as a reducing agent.

865,617. INDUCTION MOTOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 7, 1905. In an induction motor, a secondary winding comprising hollow conductors of high resistance, a pipe connection from one end of said conductors to a fluid reservoir, and a pipe connection from the other end of said conductors to a suction pump.

865,618. PRODUCTION OF NITROUS COMPOUNDS; C. P. Steinmetz, Schenectady, N. Y. App. filed April 20, 1907. The process of producing nitrous compounds, which consists in rotating a deflected electric arc within a current of air.

865,638. THERMOSTAT; Harry G. Geissinger, New York, N. Y. App. filed July 16, 1906. A thermostat having a number of strips of dif-



865,609.—Process of Smelting Refractory Ores and Producing Low Carbon Ferro Alloys.

ferent materials riveted together and located within a heating coil, so as to be deflected, and close an alarm circuit in case of excessive current in the coil. The strip of thermal element has special features of construction.

865,648. ELECTROLYSIS OF FUSED SALTS; Franz von Kugelgen and George O. Seward, Holcombs Rock, Va. App. filed May 26, 1905. Process consisting in regulating the electrolysis so that the secondary reaction between the earth alkali metal and magnesium fluorid is partially completed so that the desired alloy is obtained.

865,687. PROCESS OF MAKING NICKEL FILMS. Thomas A. Edison, Llewellyn Park, N. J. App. filed Jan. 19, 1907. The process for making films of metallic nickel which consists in depositing upon a suitable cathode alternating films of copper and nickel, in then stripping the composite sheet from the cathode, and in finally dissolving the copper in an ammoniacal copper sulphate solution.

865,688. PROCESS OF MAKING METALLIC FILMS OR FLAKES; Thomas A. Edison, Llewellyn Park, N. J. App. filed Jan. 19, 1907. The process of electroplating, which consists in chemically depositing metal on a suitable cathode, in electroplating a metal on the deposit so formed, and in mechanically removing the said deposits from the cathode.

865,697. INSULATOR; Robert E. Henderson and John N. King, Los Angeles, Cal. App. filed May 16, 1906. Form of insulator of substantially the ordinary outlines except that it is thicker on one side than the other and has a diagonal slot to receive the circuit wire.

865,701. ALTERNATE CURRENT GENERATOR AND MOTOR; A. Heyland, Brussels, Belgium. App. filed June 9, 1902. In an alternating current dynamo electric machine, the combination with relatively movable windings, of a commutator connected to one of said windings, brushes bearing upon said commutator, a circuit having a sensibly constant potential impressed upon it connected to certain of said brushes, and a circuit carrying current proportional to the current in the other of said windings also connected to certain of said brushes.

865,707. SELF-SUSTAINED FIELD MAGNET COIL; Elbert W. Jodrey, Lynn, Mass. App. filed Dec. 28, 1906. The method of producing a self-sustained universally wound wire coil which consists in winding a few layers, securing a strip of paper about said layers, and then winding on the remaining layers.

865,730. CONTROLLING SYSTEM FOR RAILWAYS; Max Trautmann, Dresden, Germany. App. filed March 21, 1907. Railway system in which a series of conductors are divided into two groups corresponding to the number of passing trains, which conductors lead from the lines to indicators, and at the place to be controlled are put in circuit by suitable line contacts operated by the passing trains.

865,732. DYNAMO OR THE LIKE; Charles A. Vandervell, London, and William H. W. Proctor, Coventry, England. App. filed March 6, 1905. A choke coil having a variable inductance is controlled by a centrifugal device. Particularly adapted for ignition systems of explosion engines.

865,771. ELECTRIC SIGNAL BELL; Harold W. Eden, Detroit, Mich. App. filed July 18, 1906. Details of construction of an electric bell composed entirely of sheet metal parts.

865,781. ELECTRIC RAILWAY SIGNALING DEVICE; Edward B. Howell, Butte, Mont. App. filed June 25, 1906. Signaling device for electric trains in which a signal is automatically produced in two trains when they approach each other within a predetermined distance. Has special trolleys with circuit connections to the train.

865,811. SYSTEM OF MOTOR CONTROL; William H. Powell, Norwood, Ohio. App. filed April 16, 1906. The series including this patent and the following eleven patents relates to various features of motor control systems and methods. Covers separate motor installations, and systems having a special generator.

865,812. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood Ohio. App. filed April 16, 1906.

865,813. METHOD AND MEANS FOR CONTROLLING ELECTRIC MOTORS; W. H. Powell, Norwood, Ohio. App. filed June 30, 1906.

865,814. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. App. filed July 27, 1906.

865,815. SYSTEM OF MOTOR CONTROL; W. H. Powell, Norwood, Ohio. App. filed Sept. 29, 1906.

865,816. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. App. filed July 30, 1906.

865,817. SYSTEM OF MOTOR CONTROL; W. H. Powell, Norwood, Ohio. App. filed Dec. 19, 1906.

865,818. SYSTEM OF MOTOR CONTROL; W. H. Powell, Norwood, Ohio. App. filed Jan. 28, 1907.

865,819. MOTOR-CONTROL SYSTEM; W. H. Powell, Norwood, Ohio. App. filed Jan. 28, 1907.

865,820. MOTOR-CONTROL SYSTEM; W. J. Richards, Norwood, Ohio. App. filed March 25, 1907.

865,821. SYSTEM OF MOTOR CONTROL; W. J. Richards, Norwood, Ohio. App. filed March 1, 1907.

865,822. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; L. E. Bogen, Cincinnati, Ohio. App. filed May 27, 1907.

865,830. CIGAR LIGHTER; Clark D. Vaughn, Philadelphia, Pa. App. filed April 9, 1907. Cigar lighter having a fluid tank or receptacle and a sparker pivotally mounted thereon and means for closing an electric circuit including a wick in said receptacle and breaking said circuit and extinguishing the flame of said wick.

865,848. AUTOMATIC SIGNALING APPARATUS; James S. Anderson, Ames, Neb. App. filed May 20, 1907. A locomotive is provided with a pair of longitudinal bars or conductors extending from end to end at a point above the same and which contact with depending plates above the track.

865,866. BLOCK SIGNAL; Pierre I. Chandeysson, St. Louis, Mo. App. filed Dec. 23, 1905. A semaphore comprising an arm or blade movable into three positions and operated by an electric motor having a magnetic clutch to control the positions of such semaphore arm.

865,879. ELECTRIC CONTACT RAIL; Ed. W. Farnham, Chicago, Ill. App. filed July 17, 1905. Arrangement for increasing the conductivity of third-rails while reducing their weight. The third-rail is made of U-shaped cross-section having a cable enclosed therein.

865,907. COIL FOR ELECTRICAL PURPOSES; Elbert W. Jodrey, Lynn, Mass. App. filed Oct. 26, 1905. Has a tubular support formed of insulating material and a pair of coils wound upon said support with their adjacent ends separated by a space, and a conductor connecting the terminals of said coils, said conductor being embedded in said support.

865,937. TELEPHONE RECEIVER; E. J. Quinby, Portland, Maine. App. filed Nov. 22, 1905. A telephone receiver consisting of a hollow metal casing flared at its outer end, an insulating bushing secured within such flaring portion and formed with an internal rabbet in its outer end, the rim of said rabbet being flared internally, the magnet, a magnet head supporting the same and seated within said rabbet, the periphery of said head being flared to correspond with the flares of said rim; and means connecting the head and bushing for forcing said head into seated position.

865,970. CONTROLLER FOR ELECTRIC MOTORS; Charles S. Lee, Troy, N. Y. App. filed June 4, 1906. Design of controller doing away with ordinary form of magnetic blow-out employed in connection with the contact cylinders. The controller is sparkless during the act of shutting off the power, and furthermore so arranged that the operator must successively engage the contacts of the controller to operate the same.